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ABSTRACT

This journal, intended for classroom teachers, provides a collection of essays organized around the theme of new horizons in mathematics and science education as well as a guide to instructional materials related to the theme. Topics addressed in the essays include digital libraries, the future of science curricula, integrated curricula, and Classroom Communication Systems (CCSs), and reports from schools on their implementation of new technologies and approaches. The guide to instructional resources is divided into sections including: (1) The Leading Edge in Classroom Practice; (2) New Directions in Curriculum: Mathematical Modeling; (3) New Directions in Curriculum: Data Analysis; (4) New Directions in Curriculum: Chaos and Fractals; (5) Curriculum That Addresses Current Issues in Science; (6) Innovative Science Instruction; (7) Integrating Technology; (8) 21st Century Tech Tools; and (9) Engaging Students with Technology. (MM)

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A Magazine for Classroom Innovators
Volume 8, Number 4, 2001

New Horizons in Mathematics and Science Education

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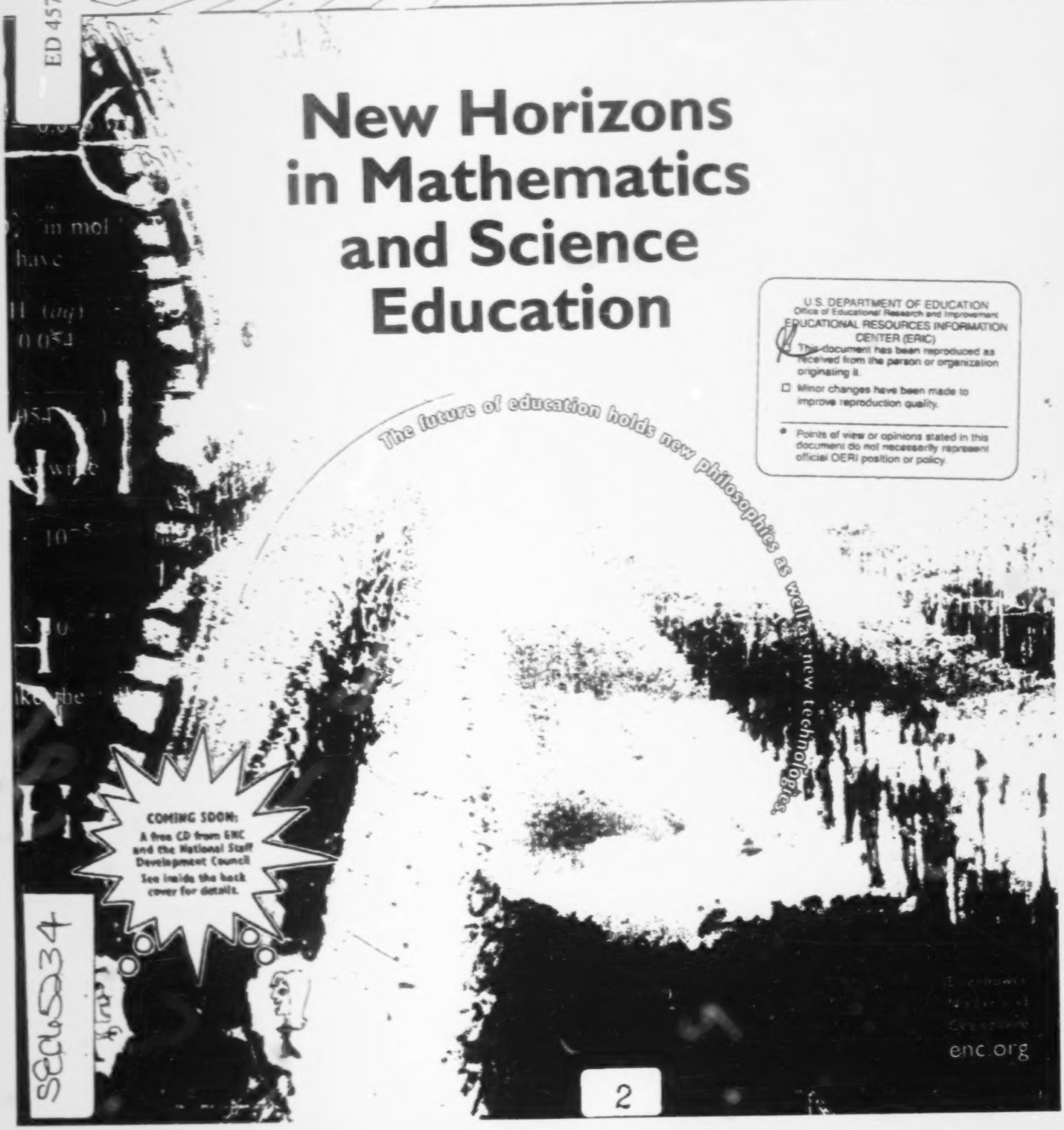

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A Magazine for Classroom Innovators
Volume 8, Number 4, October 2001

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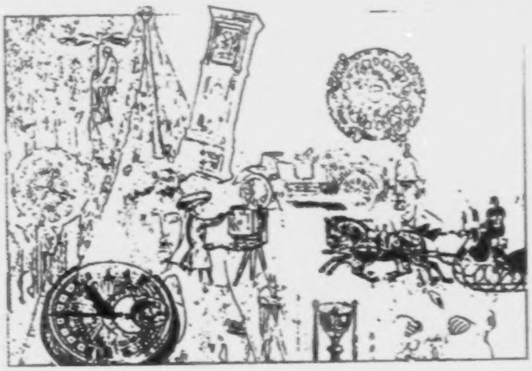

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This section features columns, essays, and news of interest to classroom innovators.

What is the Eisenhower National Clearinghouse?

Funded through a contract with the Office of Educational Research and Improvement of the U.S. Department of Education, ENC was created in 1992 to collect and catalog curriculum resources for K-12 mathematics and science educators and to disseminate information about federally funded educational programs. Our products and services have evolved to include a web site, ENC Online (enc.org), *ENC Focus*, a free quarterly magazine, and numerous other publications and services. For more information on ENC's vast collection of curriculum resources, see page 58.

Editorial

Future Shock Now and Forever

by Annette Thorson, ENC Publishing

In 1965, Alvin Toffler coined the term "future shock" to describe "the shattering stress and disorientation that we induce in individuals by subjecting them to too much change in too short a time" (p. 4). He derived the term from the then relatively new concept of culture shock, a phenomenon that was being studied in Peace Corps volunteers and others in the forefront of global interaction.

In 1970, after five years of studying future shock, Toffler published his groundbreaking book of the same name. It remains a remarkable book in many ways. For example, the index records 35 page references to computers. These are not clumped together, but embedded in nearly every discussion throughout 430 pages of text. Although Toffler did not envision the Internet—its precursor, ARPANET, was conceived in 1964 and born in 1969 (Brendon, 2001, p. 80)—he did predict that the computer would touch virtually every aspect of life.

(Interestingly enough, while Toffler foresaw the importance of the computer, he did not conceive even the current level of gender equity in the workplace. When Toffler talks of jobs, he talks in terms of men doing them.)

One aspect of Toffler's thinking that is of particular relevance to teachers is the notion that education is the answer to future shock. In 1970, he said he was appalled that:

> *Earnest intellectuals talk bravely about "educating for change" or "preparing people for the future." But we know virtually nothing about how to do it (p. 4).*

That is what this issue of *ENC Focus* is all about.

We set the tone with "The Future Isn't What It Used to Be" by ENC's Director Len Simutis (page 16). His essay challenges teachers with the difficulties ahead while expressing faith in their powers of innovation.

Other ENC staff members tackled the topic as well. Judy Ridgway presents a debate about the future of the science curriculum (page 18), and Judy Spicer polls mathematics teachers about the latest ideas in mathematics curriculum (page 22). Kim Roempler uses her regular column, Using the Internet, to describe the advent of digital libraries and what they will mean to classroom teachers (page 10).

Terese Herrera interviews an advocate of using handheld technology in mathematics class (page 26), and Laura Brendon visits a school fulfilling that vision (page 30). ENC newswriter Carolyn Hamilton summarizes new educational horizons reported online in 2001 in ENC's daily news service, ENC Education Headlines (page 32). Melanie Shreffler researches educational futurists at work today (page 35).

To get a national perspective on new educational horizons, we also turned to experts at work in the Eisenhower Regional Consortia. The resulting feature provides ten snapshots of the latest happenings from Rhode Island and Alabama to Idaho and Palau (page 42).

As always, classroom teachers and other educators in the field contribute articles. First-grade teacher Kathleen Hogan explains how she uses motion detectors to teach graphing (page 40), while Mary Ellen Verona and Susan Ragan

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describe their work with the Maryland Virtual High School (page 54), and Terri Butler reports on new uses for Cable in the Classroom (page 55). Susan Boone collaborates with far-flung fellow teachers through an electronic community (page 51), and Leslie Gordon talks about a program that integrates Alaskan native culture in science class (page 38).

The breadth and depth of this issue is impressive, but I have to admit "new horizons" is one of the toughest topics we have covered in *Focus*. At one planning meeting, the word "new" challenged us, filling us with doubts about every article:

"That idea isn't really new!"

"That practice started in another form a long time ago!"

"What does 'new' mean, anyway?"

One editor teased, "Maybe we could put New-ish Horizons on the cover?"

We finally calmed these doubts by realizing that defining what is truly new requires looking beyond the horizon. If we concentrated on that, we would have a magazine full of guesses and theorizing, and we know you are more interested in what real teachers are trying in real classrooms. We will leave predictions to futurists like Alvin Toffler, who quotes a Chinese proverb that warns:

> *To prophesy is extremely difficult—*
> *especially with respect to the future.*

References

Brendon, Laura K. (2001). ARPANET: An Efficient Machine as Social Discipline. *Science as Culture*. 10 (1) 73-95.

Toffler, Alvin. (1970). *Future Shock*. New York: Random House.

Visit ENC's Web Site
enc.org

JUMP ONLINE!

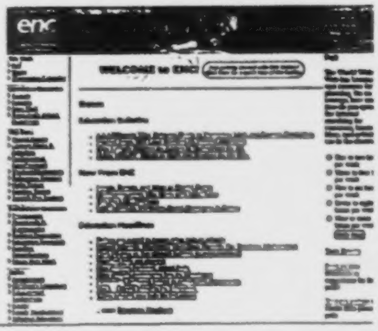
ENC Online is designed to make the resources of the Eisenhower National Clearinghouse available to educators everywhere all the time. Here is a quick introduction to the site. We urge you to "jump online" and discover for yourself how helpful enc.org can be to you.

Curriculum Resources. In this area of the site, you can use a simple or advanced search to locate all types of teaching materials in ENC's collection of approximately 20,000 items. The searches allow you to choose particular subject words, grade level, cost, and type of material to find exactly what you need for your classroom situation.

Web Links. Check this category for ENC's popular Digital Dozen feature. This monthly selection of exemplary math and science web sites can also be delivered to your email box if you choose to register. Web Links also connects to hundreds of sites with math and science lesson plans. A search feature helps you find Internet resources quickly and efficiently.

Professional Resources. This portion of the site is designed as a teachers' professional support system. ENC has gathered some of the most popular professional resources in one Timesavers area for quick linking and use. This section also provides links to the national mathematics and science education standards, and state frameworks are listed conveniently by state. Federally funded resources and professional development strategies are also available here.

Topics. Hundreds of articles, teacher interviews, and selected curriculum resources and web sites are arranged thematically in this area. Topics include inquiry and problem solving, technology, and assessment. Many of these topics include the content developed for *ENC Focus*.



ENC Online also has a quick way to get to the full text of each issue of *ENC Focus*—try the ENC Focus Magazine area of the web site. In this area, you can also sign up for a free subscription to all future issues of the print magazine.

ENC invites readers to contribute articles to ENC Focus: A Magazine for Classroom Innovators.

Join in the Dialogue! Write for ENC Focus

Topics and Deadlines:

Increasing Your Mathematics and Science Content Knowledge - Submissions due December 1, 2001

Success in the Urban Classroom - Submissions due March 1, 2002

Data-Driven Decision Making - Submissions due June 1, 2002

Topics and deadlines subject to change without notice.

See Writers' Guidelines on page 15.

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Opening the Doors of Your Practice

The National Staff Development Council sets the standards for professional learning. This organization is working with ENC to help teachers become advocates for their own professional development, as described in this article.

by **Joan Richardson,**
National Staff Development Council

Several years ago, I spent a few days observing the classroom of a highly regarded teacher in Michigan. She was a marvelous teacher, a veteran adept at smoothly differentiating her instruction to the unique needs of each of her students. During the hours I spent observing her, I was truly captivated by her energy and her wisdom.

As I left her school, two teachers pulled me aside and whispered a strange question:

What makes Katie such a good teacher?

I thought at first that these teachers were teasing me. I was a newspaper reporter at the time, and I knew only too well that some educators were skeptical about my knowledge of schools and how they operated. For a few moments, I averred that I had seen plenty to convince me that she deserved all the accolades she had received.

But they persisted. Finally, I realized the painful truth. These teachers were not challenging me at all. They were seeking information about a respected colleague. These teachers had worked classroom-to-classroom with this highly admired teacher for years. Yet, they had never set foot in her room while she was teaching. Over lunch, they had chatted amiably about families and weekend activities but never about their teaching practice. Although they shared materials among their classrooms, they had no common time during the day to talk about lessons or teaching strategies.

I think often about that conversation. It reminds me that teachers are too often isolated from the very people they trust the most. It reminds me how little regard school administrators have for the knowledge that teachers acquire simply by doing their job well. It reminds me how little understanding there is about the value of having professionals share with each other what they know about their work.

Every Teacher Is a Staff Developer

Teachers are lovers of education, and most have long ago recognized that their own ongoing education is lacking. Too many teachers fall back on complaining about being "inserviced" or about the lack of time to "talk with other teachers." To become forceful, effective advocates for their own learning, teachers must be armed with information about how adults learn best and what standards should be applied as their staff development is created.

I urge teachers to take a step in this direction by becoming familiar with the National Staff Development Council's Standards for Staff Development (see page 7). Originally written in 1995, these standards were revised this year to reflect the field's growing knowledge about adult learning.

Why should the NSDC Standards matter to teachers? Because every teacher is a staff developer. All teachers are responsible for their own personal and professional development. Because teachers are part of a larger learning community, they are also responsible, to some degree, to contribute to the learning of their colleagues.

The learning needs of teachers are not only as important as the learning needs of students, but perhaps even more important. The learning needs of teachers must be addressed so their students will learn more. At NSDC, we say, "At school, everyone's job is to learn." We cannot expect student learning to improve when teacher learning is not.

Becoming Advocates for Quality Adult Learning

Teachers must become their own advocates for the professional development that they need. That means going beyond responding to pointless follow-up questions about the Danish and coffee served at staff inservices. It even means going beyond the concept of inservice itself.

Teachers should not be satisfied with learning time that occurs only in workshops or graduate courses after school or on weekends. They should not be satisfied with school districts that expect them to handle all of their learning on their own time.

Teachers need time during the school day to examine student work, talk with colleagues about lessons, study student data, read journal articles, observe another teacher, mentor another teacher, and receive coaching from another teacher.

As teachers become better consumers of staff development, they will also become better advocates for quality adult learning. The more they understand about what they require to improve their teaching, the more effectively they will be able to press their case with parents, community leaders, school administrators, and school board members.

When that happens, no teacher should ever need to whisper into the ear of a stranger to ask why a colleague is considered a good teacher. They will know because they will have seen it for themselves.

Joan Richardson is director of publications for the National Staff Development Council. In that capacity, she serves as executive editor of the Journal of Staff Development *and other NSDC publications. For more information about NSDC, visit the web site (www.nsdc.org).*

NSDC and ENC Partner to Improve Teacher Learning

Sharing the belief that every teacher is a staff developer, the National Staff Development Council and ENC are co-publishing a professional development package, *By Your Own Design: A Teacher's Professional Learning Guide*, in January 2002. Created to help teachers become strong advocates for their own learning and that of their colleagues, the package includes a CD-ROM and a special issue of *ENC Focus*.

The CD-ROM will include a wealth of new material as well as articles from NSDC's *Journal of Staff Development* and from other publications of NSDC, ENC, and other organizations that promote professional development. The package will help teachers understand and apply the principles of adult learning, including the standards summarized here:

NSDC's Standards for Staff Development

Visit the NSDC web site (www.nsdc.org).

Context

- Learning Communities: Staff development that improves the learning of all students organizes adults into learning communities whose goals are aligned with those of the school and district.
- Leadership: Staff development that improves the learning of all students requires skillful school and district leaders who guide continuous instructional improvement.
- Resources: Staff development that improves the learning of all students requires resources to support adult learning and collaboration.

Process

- Data-Driven: Staff development that improves the learning of all students uses disaggregated student data to determine adult learning priorities, monitor progress, and help sustain continuous improvement.
- Evaluation: Staff development that improves the learning of all students uses multiple sources of information to guide improvement and demonstrate its impact.
- Research-Based: Staff development that improves the learning of all students prepares educators to apply research to decision making.
- Design: Staff development that improves the learning of all students uses learning strategies appropriate to the intended goal.
- Learning: Staff development that improves the learning of all students applies knowledge about human learning and change.
- Collaboration: Staff development that improves the learning of all students provides educators with the knowledge and skills to collaborate.

Content

- Equity: Staff development that improves the learning of all students prepares educators to understand and appreciate all students; create safe, orderly, and supportive learning environments; and hold high expectations for students' academic achievement.
- Quality Teaching: Staff development that improves the learning of all students deepens educators' content knowledge, provides them with research-based instructional strategies to assist students in meeting rigorous academic standards, and prepares them to use various types of classroom assessments appropriately.
- Family Involvement: Staff development that improves the learning of all students provides educators with knowledge and skills to involve families and other stakeholders appropriately.

Tell your colleagues!

By Your Own Design: A Teacher's Professional Learning Guide will be included FREE in the January, 2002, issue of *ENC Focus*. For details and to subscribe, see the inside back cover of this magazine.

Improving Mathematics and Science Education

EISENHOWER NETWORK

ENC is part of the National Network of Eisenhower Regional Consortia and Clearinghouse, a nationwide collaboration that provides support to mathematics and science educators across the country. In addition to ENC, the Eisenhower Network includes ten Eisenhower Regional Consortia that work toward these goals:

- To identify and disseminate exemplary mathematics and science instructional materials;
- To provide technical assistance to educators in implementing teaching methods and assessment tools;
- To collaborate with local, state, regional, and national organizations engaged in educational improvement.

Also part of the Eisenhower Network are 12 ENC Demonstration Sites—one in each region, one at ENC on The Ohio State Univesity campus in Columbus, Ohio, and one at The George Washington University in Washington DC. These sites provide visitors with the opportunity to access ENC services electronically and to pick up free publications.

In recent years, the Eisenhower Network has spread even further with the creation of ENC Access Centers. Located throughout the country, these volunteer centers are staffed to distribute ENC publications and to teach local educators about the Eisenhower Network. There are already 125 Access Centers, with more added each month.

Contact the Eisenhower Consortium or ENC Demonstration Site that serves your state for assistance in improving mathematics and science education.

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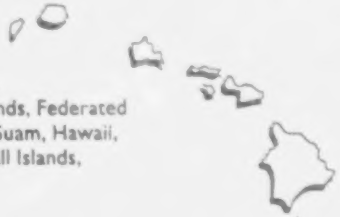

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Mid-continent Region

Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, Wyoming

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Southwest Region

Arkansas, Louisiana, New Mexico, Oklahoma, Texas

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demo site

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Northeast and Islands Region

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Appalachia Region

Kentucky, Tennessee, Virginia, West Virginia

Consortium

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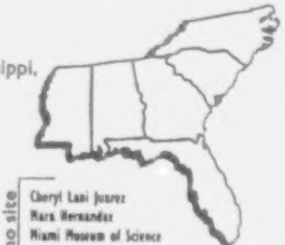
Southeast Region

Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina



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Digital Libraries for You

The World Wide Web is becoming more complex with every passing moment. Educational digital libraries will help you make the most of it.

by Kimberly S. Roempler,
ENC Instructional Resources

Imagine sitting down at a computer and designing a lesson by accessing video, text, audio, software, and other resources on the World Wide Web. For instance, suppose you need a lesson on the hydrosphere for sixth graders. You want the lesson to last 45 minutes, and you would like to include an interactive applet that covers the water cycle, two minutes of video, a short essay for students to read, and an activity that students can take home and do with parents. You type all these requests into a search engine, click on Submit, and instantly the resources are delivered to your computer. Sounds pretty amazing, doesn't it? Educational digital libraries will make it a reality.

The Learning
MATRIX

The term "digital library" is confusing to many people. In fact, it is reminiscent of the term "horseless carriage" before the coining of the word "automobile." Right now we are using the term digital library because we don't have a better way to describe it—just as the first people to see an automobile couldn't think of a better term than horseless carriage.

What Is an Educational Digital Library?

Resources are cataloged in an educational digital library just as they are in a traditional library, but in much greater depth. In addition to traditional bibliographic data such as title, author, and subject, resources in an educational digital library are described with a wide range of information of particular interest to educators. For example, in the case of software, the description might include how interactive the resource is; other data might be the audience for whom a resource was developed, where the learning will take place, or the level of difficulty of the material, just to name a few.

Most digital libraries are more sophisticated than search engines such as Google.com, or the web in general. Google.com reads text and infers meaning from the resource and also checks links between sites. When a user enters the word "safety" in the search engine, Google.com has trouble differentiating between lab safety, safety in schools—or safety pins. The search word "grade" could mean slope (civil engineering) or middle school. Because resources in educational digital libraries are described at such a fine level of detail, these inference errors won't happen.

Online catalogs now provide information about traditional library resources. You don't have to go to the actual library to check the card catalog any more, you still have to physically go to the library if you want to view or check out the resource you have identified online. In contrast, when you access the catalog of a digital library, you get the resource itself, not just a description.

Digital libraries provide instant, around-the-clock access to complete versions of the resources.

Until recently, ENC provided an online catalog. Users came to enc.org to access descriptions of materials sitting on the shelves of our collection. But more and more, ENC is cataloging resources that can be instantly accessed. You can link from the ENC description right to the resource itself. This is a small step in the direction of ENC's becoming a digital library.

The Learning Matrix at ENC

Recently ENC received a grant to develop a collection of resources to improve the preparation of math and science teachers by supporting faculty who teach math and science courses in two- and four-year colleges. The project, called the Learning Matrix, is part of the National Science Foundation's National Science, Mathematics, Engineering, and Technology Education (SMETE) Digital Library (NSDL) Initiative. ENC is also collaborating with a group of universities that is developing the infrastructure that will support the NSDL Initiative.

As part of the Learning Matrix project, we are developing a web site (thelearningmatrix.enc.org) that will contain information about and examples of best practices in undergraduate teaching. We are paying particular attention to web resources with challenging mathematics and science content, course descriptions, syllabi, and lesson plans. Links to electronic communities and professional organizations will also be included.

The site will offer peer-reviewed materials, such as assessments, projects, and video clips, that illustrate standards-based teaching on the college level. Another important component will be an enriched web-based learning environment where visitors interact with their colleagues' materials to gain deeper understanding of the substance and context in both research and practice.

How will ENC's involvement with the NSDL project benefit K-12 teachers? In the short term, the services and technologies developed through the project and all the lessons learned in the process will be applied to the classification and indexing of the curriculum resources in ENC's collection. In the long term, you will be the teacher accessing a world of resources to make an instantaneous, multimedia lesson on the hydrosphere to use with your sixth graders.

Kimberly Roempler is ENC's associate director of Instructional Resources and director of The Learning Matrix, the NSDL Initiative at ENC. Email: roempler@enc.org

Roempler's Recommended Resources

The Science, Mathematics, Engineering, and Technology Education (SMETE) Digital Library provides direct access and delivery of instructional resources from a federation of digital libraries content repositories.

www.smete.org

National SMETE Digital Library Community Center details the progress on the National Science Foundation's SMETE Digital Library Initiative.

www.smete.org/nsdl/index.html

D-Lib Magazine is a monthly online magazine about innovations and research in digital libraries.

www.dlib.org

Digital Library Federation offers information about developing digital collections and managing networked information.

www.clir.org/diglibdlfhomepage.htm

DLESE—Digital Library for Earth Systems Education is an information system dedicated to the collection, enhancement, and distribution of materials that facilitate learning about the Earth system at all educational levels.

dlese.org/

MERLOT—Multimedia Educational Resources for Learning and Online Teaching is an online community that allows users to search for learning materials, reviews, assignments, and people.

merlot.org/Home.po

JOMA—Journal of Online Mathematics and Its Applications publishes innovative, class-tested, web-based learning materials, articles on design and use of online materials, original research articles on student learning via online materials and other technology-rich environments, surveys of existing online materials, and high-quality "mathlets."

www.joma.org/

Photos: PhotoDisc

Visit ENC's Classroom Calendar

Classroom Calendar is loaded with ideas for teachers to use in their classrooms.

Based on ENC's collection of curriculum resources and selected web sites, Classroom Calendar events include:

- A description of the event
- Background information
- Ideas for curricular connections
- A list of related web sites
- Classroom-ready online activities
- An annotated bibliography of ENC resources

Plus, events are correlated to national mathematics and science standards.

Some upcoming events on the calendar include Bats on October 31 and Math Games during the week of November 18-24, but remember you can use these activities any day of the year.

Bats (October 31)

Bats and Halloween are a traditional combination, but the implication that bats are scary or evil is not true! Arguably, there are more misconceptions about bats than any other creature. October 31st is the perfect opportunity to counter all the misinformation by learning more about these wonderful creatures. Bats are found all over the world, providing a natural connection to a geography lesson. The anatomy of bats can make for an interesting lesson as students compare a bat's wing with a human arm.

Math Games (November 18-24)

Celebrate National Game and Puzzle Week by taking class time for students to play some math-related games. Games and puzzles provide a fun way for students to acquire and practice math skills such as problem solving, logic, pattern recognition, and number sense.

As a class, analyze the math skills used in the games you play, think about how the skills are used in everyday life, learn about games from around the world, and maybe even invent your own games.

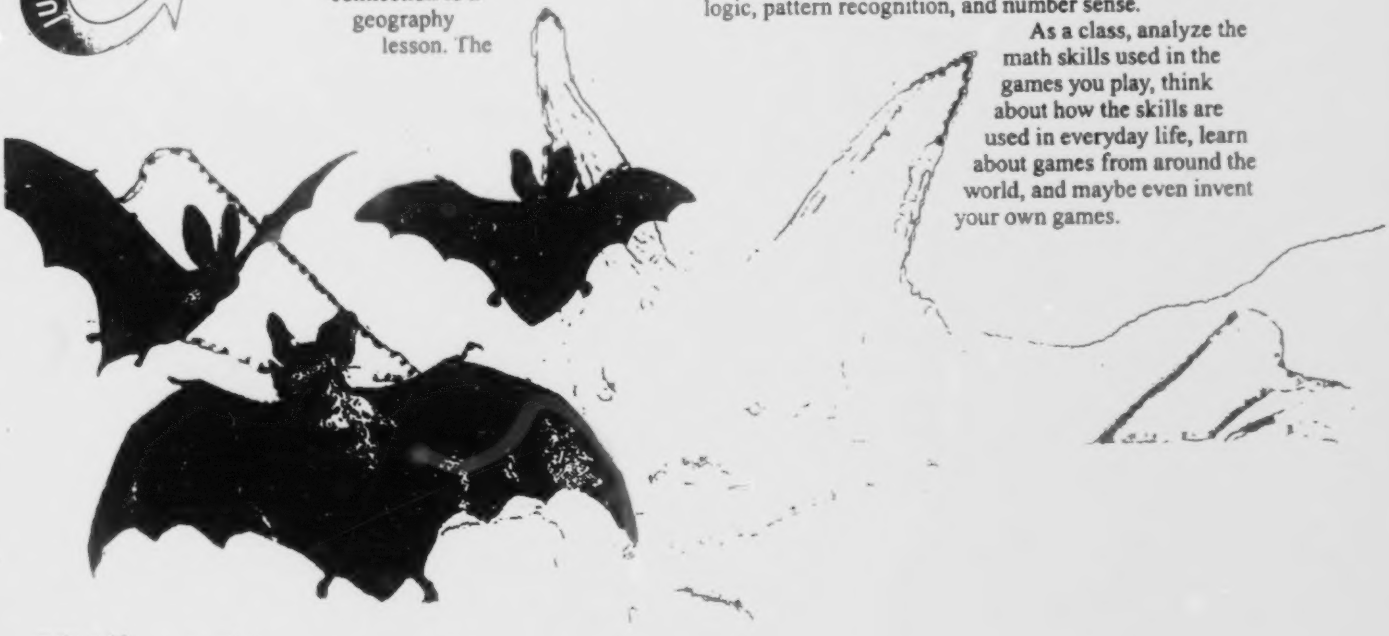

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Illustration: Dover Publications. Background photo: U.S. Fish & Wildlife Service

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① **I am a . . .**

__________ teacher—please indicate grade level ________ and subjects you teach __________

__________ building or district administrator
__________ library/media specialist
__________ parent
__________ college student majoring in education
__________ technology coordinator
__________ college or university faculty member
__________ professional developer
__________ curriculum specialist
__________ other (please describe) __________

I have __________ years experience as an educator.

② **As an educator, I do the following (check all that apply):**

	Daily	Weekly	Monthly	Yearly	Never
Attend an education conference	☐	☐	☐	☐	☐
Read a professional journal or other professional materials . . .	☐	☐	☐	☐	☐
Collaborate with teachers in my building on projects or professional activities	☐	☐	☐	☐	☐
Try new ideas in my classroom	☐	☐	☐	☐	☐
Visit or observe other classrooms	☐	☐	☐	☐	☐
Analyze assessment or survey data from my classes or school(s)	☐	☐	☐	☐	☐
Assume leadership responsibilities in my school	☐	☐	☐	☐	☐

③ **I use the following in my work (check all that apply):**

__________ A computer at school
__________ A computer at home
__________ The Internet
__________ Email
__________ ENC Online (enc.org)

④ **I connect to the Internet (check all that apply):**

	Daily	Weekly	Monthly	Yearly	Never
To search for classroom materials and/or ideas	☐	☐	☐	☐	☐
To integrate Internet materials into my classroom activities . .	☐	☐	☐	☐	☐
To buy classroom materials	☐	☐	☐	☐	☐
To participate in online discussion groups with other educators	☐	☐	☐	☐	☐
To learn more/do research in my subject area	☐	☐	☐	☐	☐
For leisure activities such as finding sports scores or travel information	☐	☐	☐	☐	☐
Other (please describe)	☐	☐	☐	☐	☐

⑤ **In terms of other ENC services, I have (check all that apply):**

Requested products through

__________ ENC Online
__________ 800 number
__________ Fax
__________ Mail
__________ Email

Requested a product from ENC that arrived

__________ Within 10 days
__________ Took longer than 10 days to arrive
__________ Never arrived

__________ Requested multiple copies of ENC products by 800 number, fax, mail, or email
__________ Used the ENC reference services
__________ Visited an ENC Demonstration Site
__________ Visited an ENC Access Center
__________ Visited an ENC exhibit at a conference
__________ Heard an ENC staff member speak about ENC

⑥ When I receive *ENC Focus* . . . (check all that apply)

__________ I read it from cover to cover
__________ I read some articles
__________ I pass it on to others
__________ I save it
__________ I copy articles and/or file them
__________ I go to the online version at ENC Online (enc.org)
__________ I try the activities described
__________ I purchase resources that I read about
__________ I think about my teaching in a new way

⑦ I would like to read more about the following in *Focus*:

⑧ **I suggest the following to improve ENC's products and services:**

__________ **Please continue on the back panel**

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1929 KENNY RD
COLUMBUS, OH 43210-1079

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HERE

Fold Here First

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Write for ENC Focus

Detailed Writers' Guidelines are available online at

enc.org/focus/write

Guidelines for Content of Articles

ENC publishes print and electronic materials on specific topics of interest to teachers of K-12 mathematics and science. Articles submitted for consideration should be grounded in the national educational standards while being short (500 to 2,000 words) and compelling. It is essential that articles promote educational equity and advance the principle of "education for all."

We particularly invite teachers to write about their classroom experiences, using first person and a conversational tone. Please note that library research papers written in academic language for graduate school courses are unlikely to be selected for publication. We do, however, encourage you to include a few, carefully chosen references or a brief reading list. All content must be original, and all quotations must be properly cited.

We also publish essays by K-12 students about their successes in mathematics and science. Teachers are encouraged to assist students in writing and submitting materials for publication.

ENC is not interested in publishing articles that have the main goal of promoting commercial products.

Guidelines for Photographs and Illustrations

Photos or other illustrations add interest, and good illustrations increase your chances for publication. Photos should show students involved in an activity rather than looking directly at the camera. Students in laboratory settings must be shown following appropriate safety guidelines and wearing proper safety attire, including eye protection. Please select photos that depict diverse students and teachers working together.

Please note that we can use photos of children under 18 years of age only if we receive written permission signed by a parent or guardian. It is important that the form specify that permission is granted for use of the image on the Internet as well as in print. ENC will provide permission forms on request.

Photos, slides, negatives, drawings, or charts may be mailed to the editor. We prefer color, but black and white photos are also acceptable. Photos should be at least 4x6 inches. Tape an identifying label on the back of each item rather than writing on it. Photos and other illustrations or materials will be returned only on request. Keep in mind that we will not be able to return any material until after the magazine is printed.

If you use a digital camera, please take photos at your camera's highest setting, which may be 1024x768 or 1240x960. You can then attach those photos to an email or send them to us on a disk. Scanned images need to be at least 300 dpi; the dimension of the image should be at least 4x6 inches. Save the images as jpeg files. Digital photos printed on photographic paper with an ink jet printer are not acceptable because the resolution is inadequate for reproduction.

Submission Details

Authors of unsolicited manuscripts are urged to send a brief proposal via email well in advance of the deadline for the upcoming topic. Proposals should explain how the article fits the topic and how it serves the needs of K-12 teachers. Future topics and deadlines are regularly published in both the print and online versions of the magazine.

We prefer that manuscripts be submitted electronically. A Microsoft Word or text file attached to an email message works well. Manuscripts can also be submitted by fax or regular mail. Paper submissions must be typed in a large, clear font; this is especially important for those sent by fax.

Each manuscript must be accompanied by the full names, postal addresses, telephone numbers, and email addresses of all authors. In addition, each author must be further identified with one or two sentences providing the author's professional affiliation and background.

We cannot consider manuscripts that have been submitted elsewhere. Occasionally we reprint outstanding articles that have been previously published. Authors suggesting their own articles for reprint must provide written permission from the original publishers.

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The Editing Process

Your proposal or manuscript will be acknowledged as soon as possible after it is received. Inclusion of your email address greatly speeds this response.

Please keep in mind that just because an article has been acknowledged does not mean it has been accepted for publication. Sometimes we cannot determine whether a particular article will be published until all articles for the issue have been edited.

All articles, solicited and unsolicited, are reviewed by ENC's mathematics and science education experts both before and after they are edited, and edited articles are reviewed by officials at the U.S. Department of Education. At any step in this process, ENC reserves the right to decline to publish any article, to delay publication until a later issue, or to publish an article online and not in the print version of the magazine.

During the editing process, you may be contacted to answer questions about your article. Or you may just receive an edited version of your article for your approval. At this point we need an immediate response, even if the article is correct to print as edited.

Please keep in mind that articles may be changed significantly to suit the needs of our audience, to match our style, or to fit in the space available. We want the edited version to be factually correct and to express your views accurately, but ENC retains the right to make final editing decisions.

When Your Article Is Published

ENC mails five copies of the print version of the magazine to each author. Requests for bulk shipments of the print version will be filled while supplies last.

For upcoming topics, see page 5.

For more information or to submit a manuscript, contact:

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Focus on

New Horizons in Mathematics and Science Education

This section presents articles on the theme of this issue

Themes for ENC Focus

Each issue of *ENC Focus* presents articles on a topic of concern to classroom innovators. Previous issues have covered topics such as Teaching in the Standards-Based Classroom, Making Schools Work for Every Child, Mathematics & Science in the Real World, Assessment That Informs Practice, Integrating Technology in the Classroom, and Inquiry & Problem Solving. The online version of ENC Focus (enc.org/focus/) provides the full text of all issues.

The best source of new ideas and helpful tips for improving science and mathematics education is the classroom teacher. We invite you to join the community of ENC Focus writers. Check page 5 for upcoming themes. Our guidelines for writers appear on page 15 and online (enc.org/focus/writer).

The Future

Schools have always functioned in the larger context of societal trends. As a new wave of change surges through society, meeting the challenge will depend on innovative classroom teachers.

by Len Simutis, Director, Eisenhower National Clearinghouse

This issue of *ENC Focus* explores "new horizons" for programs and resources to address the pervasive need for major improvement in K-12 mathematics and science education. These new initiatives hold real promise for bringing about significant increases in student achievement in mathematics and science.

Many of the initiatives spring from your innovative approaches to instruction and the creation of learning communities in school districts across the country. However, all educational reform must ultimately be grounded in the changing technological, social, and economic context for K-12 education. It is crucial for us to deal with the implications of these broader societal changes and to recognize both the opportunities and the pitfalls those changes will create for K-12 students and teachers.

Some of the major changes are occurring in technology, in educational financing, and in the nature of family and work in our society. Taken separately, each will have an important impact on the nation's schools; taken together, these forces have the potential to fundamentally transform the very nature of education as we know it today.

Technology provides a clear example. Over the last 20 years, our first effort in this arena was an attempt to retrofit 19th-century school buildings with desktop computers and wired networks. Meanwhile, advances in handheld computing devices along with increased bandwidth are creating a whole new environment for instructional technology. The result is learning that is more engaging and more accessible to students 24 hours a day. Keeping up will demand a continuous wave of investment in educational technologies—in our homes as well as in our schools.

Another costly challenge is a long-term shortage of K-12 teachers, particularly those with content knowledge in mathematics and science. School boards will have great difficulty in finding the funds necessary to attract and retain well-qualified teachers, as well as to equip schools with the new technologies and information resources those teachers will view as necessary for them to be effective.

It is also clear that new publishing models and content providers will develop the instructional materials of the future. The traditional textbook will be replaced with just-in-time resources, and assessments will be adapted to address local and state standards.

Finally, changes in family structure and the nature of work are already complicating school access for parents. Attending teacher conferences or other school meetings—or even picking up a sick child in the middle of the day—may be extremely difficult for parents who no longer work regular hours at a location near their place of residence.

All these changes call for educators who are willing to work with students, parents, and the community to create educational settings that are less conventional, but potentially more stimulating and successful.

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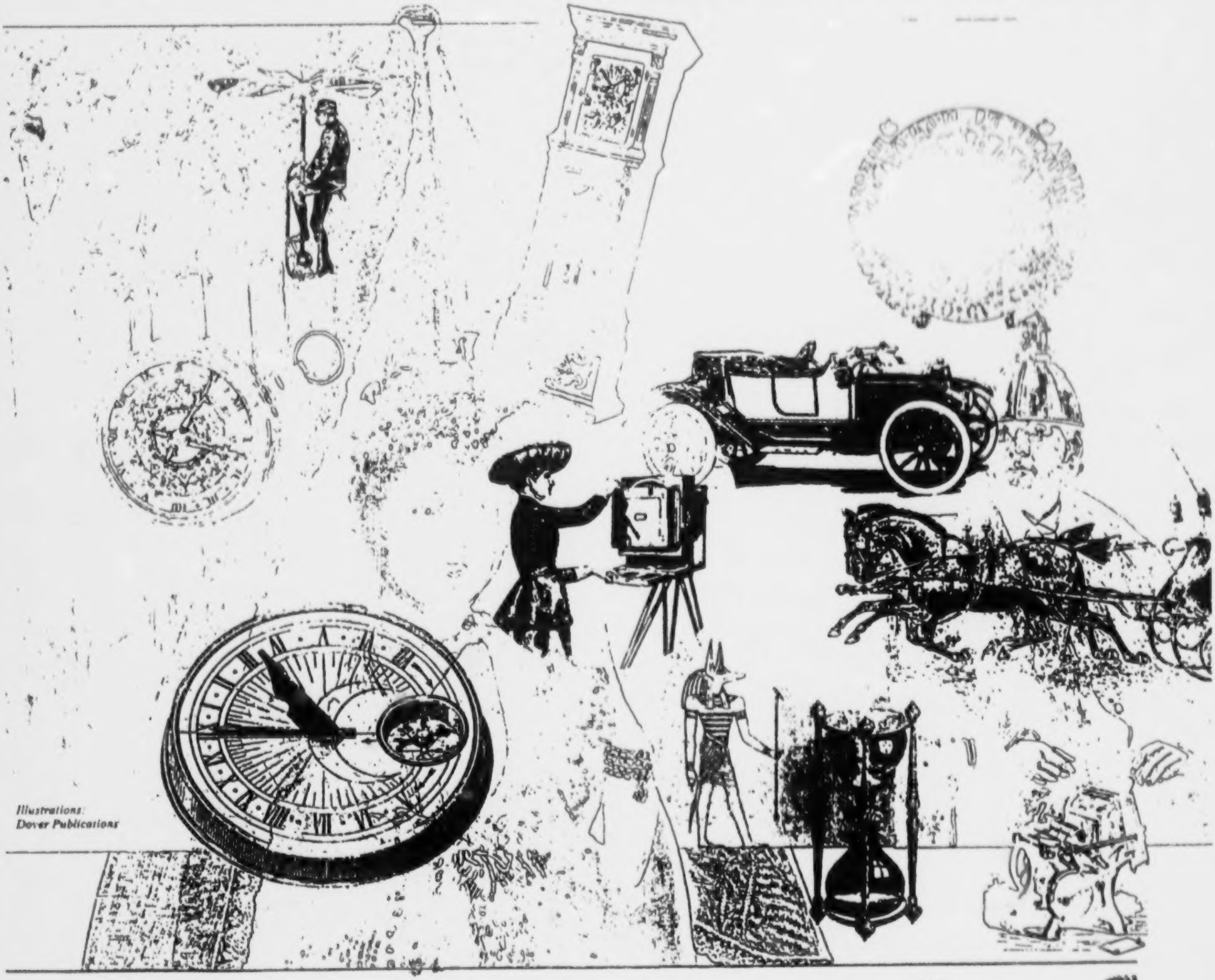
Isn't What It Used to Be

The educators of the future must be willing to adopt unfamiliar technologies. They must be willing to work in alternative instructional settings, perhaps in the workplaces of parents or in other community settings outside the school. They must be willing to work with nontraditional educational content providers, on their own or with publishers, to create rich instructional resources that are primarily technology-based and that can be accessed effectively at home as well as at school. And they must be willing to develop and nurture new types of learning communities that embrace collaboration, community-based learning, and the increasing diversity of our students and teachers.

In short, educators of the future must be classroom innovators—like you!

Len Simutis is director of the Eisenhower National Clearinghouse at The Ohio State University. He also has key responsibilities with several other projects, including the NSF Digital Library program, the Ohio Resource Center for Mathematics, Science, and Reading, and the Gateway to Educational Materials Governing Board, which he co-chairs. He has served on advisory committees for the National Academy of Sciences, the National Council of Teachers of Mathematics, the National Science Teachers Association, the International Technology Education Association, and the National Library of Education.



Illustrations: Dover Publications

Debating the Science Curriculum of the Future

There is more than one opinion on the best way to teach science, as illustrated by this debate between two visionaries—one from science and one from science education.

by Judy Ridgway, ENC Instructional Resources

The 2000 conference of the National Association for Research in Science Teaching (NARST) was memorable for me because of a session that featured a lively discussion among Nobel Laureate in Physics Leon Lederman, classroom teacher Louis Rosenblatt, and science education researchers William Cobern and Robert Yeager. The panel discussion was arranged by Jan Morrison, principal of Friends School of Baltimore, who said that the symposium had been "designed not to bring forth answers to questions about the high school science curriculum but to lay out the issues so that there is greater appreciation of the complexity of the questions."

Lederman presented his arguments for Physics First, a high school science curriculum that begins with physics, followed by chemistry and then biology. Alternative positions were offered by the educators.

Recently, I spoke to Lederman and Cobern about their positions on the Physics First model and their views about the future of science education. Highlights from those two conversations are presented beginning on page 19.

It is obvious that even though their opinions differ, both Lederman and Cobern share a passion for improving science education. Their dialogue exemplifies a growing trend. More and more scientists are joining educators in proposing systemic changes in education. As they do, it is vital that the scientists listen to and take into consideration the experiences and understanding of career educators. Similarly, educators need to recognize that the scientists' perspectives broaden the discussion.

I hope that the coming years will bring more collaboration between scientists and science educators. If everyone keeps an open mind, the points of tension in these discussions will yield productive ideas that will benefit all students and society as a whole.

William W. Cobern is professor of science education and associate dean for Academic Programs in the College of Education at Western Michigan University in Kalamazoo. The National Science Foundation has funded his empirical studies of culture and science education, and he has worked with the NSF-sponsored Comprehensive Regional Center for Minority Education in Arizona. Cobern has served on the editorial board for the *Journal of Research in Science Teaching*. He is the section editor for Culture and Comparative Studies for the journal *Science Education* and is a charter editorial board member for the *Canadian Journal of Science, Mathematics and Technology Education*.

Leon Lederman, winner of the 1988 Nobel Prize for Physics, is director emeritus of Fermi National Accelerator Laboratory in Batavia, Illinois. In the field of education, he founded and chairs a professional development program for primary school teachers in the Chicago Public Schools. This initiative is now being replicated in inner-city schools in East St. Louis and Joliet, Illinois. Lederman has been instrumental in creating the Illinois Mathematics and Science Academy, a residential public high school for gifted children. For more information about the Physics First curriculum, visit the web site (www-ed.fnal.gov/arise/arise.html).

Judy Ridgway is ENC's Assistant Director of Instructional Resources. She is a veteran educator in the biological sciences. Email: jridgway@enc.org

Related Readings

Cobern, W.W. (2000, April). The Rhetoric of Science Education Reform. Paper presentation prepared for the annual meeting of the National Association for Research in Science Teaching symposium, What Science Should We Teach? In What Sequence? How Do We Know? New Orleans, LA.

Lewin, T. (1999, January 24). A Push to Reorder Sciences Puts Physics First. *The New York Times*.

Rosenblatt, L.B. (2000, April). On the Logic of the Classroom. Paper presentation prepared for the annual meeting of the National Association for Research in Science Teaching symposium, What Science Should We Teach? In What Sequence? How Do We Know? New Orleans, LA.

Two Views of the Science Curriculum

Leon Lederman's View

Suppose you were teaching math and you said, "We are going to start math with calculus, and then after calculus, we will get down to adding and subtracting and multiplying and dividing." Anybody who proposed such a sequence would be arrested, locked up, or otherwise hustled off the scene.

Starting the high school science curriculum with biology is about like starting the study of mathematics with calculus. Biology is the most complex of all the basic sciences. An understanding of modern biology depends on an understanding of the structure of large, complex molecules.

The sciences have a hierarchy based on atoms. That was not known in 1893 when the present sequence—biology, chemistry, and physics—was installed in our high schools on the recommendation of the Committee of Ten (see box on page 20). It is a comment on how slowly schools change that we are still teaching this 1893 sequence even though the sciences have rushed ahead.

Currently, students forget ninth-grade biology when the exam is over. For one thing, the course requires them to memorize and regurgitate thousands of new Latin words, and for another, they don't build on the concepts the following year. With Physics First, students use physics in the following year's chemistry class because almost every process in chemistry has a physics explanation for it.

There is a tremendous misconception about physics requiring advanced calculus. In reality, the Physics First sequence allows students to use learning from Monday's mathematics class in Tuesday's science class. The conceptual physics courses use ninth-grade algebra to explain, for example, that the parabolic path of Michael Jordan's basketball shot is the resolution between throwing the ball and having gravity pull on it. Students can appreciate that the math that they are learning is useful in their physics class.

In an ideal situation, every Monday, the science, math, and humanities teachers sit down together for several hours and discuss their coordinated strategy for the week. The collaboration of these teachers of different disciplines is necessary because science is connected knowledge, and knowledge without wisdom is dry as dust.

In addition, the math, physics, chemistry, and biology teachers would sit down and make a solemn pledge to give up some fraction of the content of each of their courses. What you want to teach in addition to the content is the process of science; some of its history; why it works. What we want our young

Continued on page 20

William Cobern's View

I agree with many of Professor Lederman's views. I have followed his work since he received his Nobel Prize. He is a wonderful man, he writes well, and he has great ideas.

Certainly we agree on the concept of collaboration among teachers. There is a great deal in the research base that indicates that one of the most important factors for school success is the cohesion of the community.

That means that a group of teachers is committed to a particular curriculum or style of teaching that is supported by the community in which they teach. Lederman supports his arguments by citing a number of schools in which the Physics First curriculum has succeeded. However, other schools have demonstrated that other approaches can also be successful because these schools have a coordinated, cohesive approach to what they are doing.

Physics First is what we would call a structure of science approach. This approach goes back to Joseph Schwab's work in the 1960s and to the early National Science Foundation projects. The notion of developing a science curriculum based on the structure of science never really panned out. Physics First is not doing the same thing, but there are substantial similarities. I am not saying that because it did not work before, we should not do it now. However, since it didn't work before, we need to find out why it didn't work. There is no sense in trying something again if you don't understand what the problems were the first time.

I also have difficulty with the manner in which Lederman presents his views. First, he has a penchant for devaluing the expertise of those who have been doing research in the science of education for years. Second, when he promotes his own ideas, it is in the context that if we don't follow his plan there will be dire results. I think that wears thin on people—both educators and the public.

Nevertheless, I do agree with Lederman that we can and must do a better job teaching mathematics and science. However, the issue of students learning high school science is very complex. Physics First is a reform based on one particular view. I don't think programs designed in isolation of other factors are going to have a significant effect on the system.

I believe science should be taught from elementary through high school using true inquiry, where youngsters have a chance to use the learning cycle to investigate phenomena, talk about their evidence, and then talk about scientists' formal ideas. That is not a new

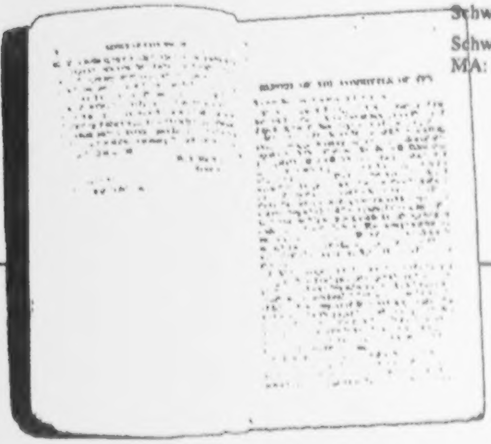
Continued on page 20

Leon Lederman's View... continued

people to remember is the "science way" of thinking because they will forget many of the details.

Let me finally add that a slowly growing number of schools are experimenting with reordering the sequence. They overwhelmingly report greatly enhanced enrollment in science electives.

See the article on page 21 for a description of one high school that is trying the Physics First curriculum.



William Cobern's View... continued

idea but it remains central. It is the most important single change in K-12 education in that it increases student interest. One thing that discourages interest in science is direct instruction, whether it is lecture from the teacher or simply reading information from a book

A spiral curriculum makes sense. In a cohesive, integrated science program, students are exposed to simplified ideas from all scientific disciplines at an early age. Then as students move through the grades, they revisit the ideas in more depth. In the spiral, there would be times when physics ideas would indeed be first, but adopting an approach like Physics First is a rather simplistic solution to the very complicated issues involved in the teaching of science.

References

DeBoer, G. E. (1991). *A History of Ideas in Science Education: Implications for Practice*. New York: Teachers College Press.

Schwab, J. J. (1960). What do scientists do? *Behavioral Science*, 5, 1-27.

Schwab, J. J. (1962). *The Teaching of Science as Enquiry*. The Inglis Lectureship. Cambridge, MA: Harvard University Press.

The Committee of Ten: A Century of Influence

The National Educational Association appointed the Committee of Ten in 1892. The NEA charged the Committee to recommend a uniform high school curriculum that would prepare students for college. Even a high school education was not universal at that time.

Charles W. Eliot, president of Harvard University, chaired the Committee; other members included William Torrey Harris (the U.S. Commissioner of Education), college presidents, and professors. The Committee reported in 1893 that all students, regardless of whether they planned to go to college, trade or scientific schools, should participate in a similar curriculum. The Committee also recommended college entrance requirements and methods of testing high school achievement.

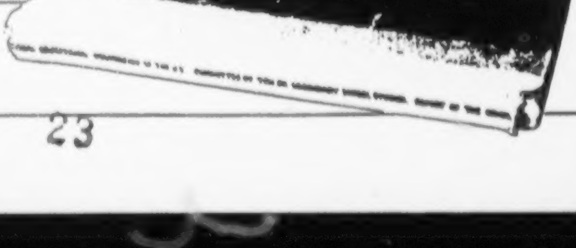
The Committee's report influenced movements to accredit high schools and establish a uniform high school curriculum. Its recommendations extended to details such as the division of the school day into "periods" based on the subject being studied.

—Laura K. Brendon, ENC Information Services

References

The Essential Ted Sizer. (1996, December 4). *Education Week*, Retrieved July 2, 2001: www.edweek.org/ew/ewstory.cfm?slug=14sizer2.h16&keywords=%22committee%20of%20ten%22

United States Bureau of Education. (1893). *Report of the Committee on Secondary School Studies*. Washington, DC: Government Printing Office.



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A District That Puts Physics First

A Connecticut school district puts Lederman's vision to the test.

by Kenneth R. Roy, Glastonbury, Connecticut, Public Schools

The traditional sequence of courses for high school science is first biology, then chemistry, and finally physics. Under this model, few students study physics. Of the students who take biology first, then chemistry, only about 25 percent of the "survivors" take physics (Bardeen & Lederman, 1998).

The traditional sequence was established in 1893 on the recommendation of a prestigious national commission known as the Committee of Ten (see page 20). Needless to say, significant changes have taken place in each of the sciences since that time. The rate of change has quickened in the past 20 years with the advent of computers and advances in information management and processing. At the same time, there have been major advances in molecular biology and new discoveries fostering connections among the physical and biological sciences. Surely the time has come to update the high school science curriculum to keep pace with all these changes.

A Call to Change

Beginning with *A Nation at Risk* (1983), direction for change in science education has been provided by national educational reform movements and reports such as the American Association for the Advancement of Science (AAAS) Project 2061 (1989), National Science Teachers Association (NSTA) Scope, Sequence, and Coordination project (1996), and the *National Science Education Standards* (1996). One reform movement that directly addresses high school curriculum sequencing is the American Renaissance in Science Education (ARISE).

Based in part on the tenets of other national reform movements, ARISE asserts that knowledge of physics fosters learning in chemistry. In turn, knowledge in chemistry fosters learning in biology. In effect, ARISE proposes to reverse the traditional model of the secondary science curriculum sequence.

In 1996, my school district, the Glastonbury, Connecticut, Public Schools, explored the ARISE approach to secondary science education. Although this approach is controversial (see the debate starting on page 18), we were convinced that it had merit. We felt it would expose students to major concepts in all the sciences in addition to fostering better understanding of the relationship between the sciences.

The science department began by designing a five-year pilot program for high-achieving students. Table 1 compares the traditional program in grades 8 to 12 with the pilot program modeled after the ARISE approach. If the pilot proved to be successful, we planned to change to the science program for the entire school population.

Table 1.

Original Proposal:
Science Sequence for High-Achievement Students

Grade	*Program Before 1997*	*Pilot Program (1997-2001)*
Grade 8	General Science	Conceptual Physics
Grade 9	Biology level I	Chemistry level I
Grade 10	Chemistry level I	AP Biology
Grade 11	Physics or elective	AP Chemistry
Grade 12	Physics or AP elective	AP Physics

Results of the Pilot Program

Since the initiation of the program, the first group of pilot program students has successfully taken Conceptual Physics in grade 8, level I Chemistry in grade 9, Advanced Placement (AP) Biology in grade 10, and AP Chemistry in grade 11. As of this writing, grade 12 students are enrolled in the new, two-credit AP Physics course.

The first three years of the pilot have produced positive results by increasing students' exposure to the physical sciences. For example, the number of students taking AP Chemistry jumped from 22 in 1997-98 to 48 in 2000-01. The program also allows students to take more science courses. They now have the opportunity to take three years of AP coursework in science or other science electives (see Table 2).

Another benefit of the program is the increasing involvement of girls in our school's science program. Since we instituted Physics First, enrollment in the 10th-

Table 2.

Second Phase: Physics-First Sequence for All Students

Grade 8	Conceptual Physics
Grade 9	Conceptual Chemistry or College Preparatory Chemistry
Grade 10	Conceptual Biology or College Preparatory Biology or AP Biology
Grade 11	College Preparatory Chemistry or AP Chemistry or Science Electives
Grade 12	College Preparatory Physics or AP Physics or Science Electives

Electives include Anatomy & Physiology, Botany, Genetics, Geology, Meteorology, Oceanology, and more.

grade AP Biology class increased from 26 percent female to 54 percent female. AP Chemistry class enrollment for grade 11 increased from 33 percent female to 48 percent female students. I believe part of the reason for this change is that all students in grade 8 are now introduced to Conceptual Physics. This introduction allows girls to gain more confidence—they know they can do the work.

Various assessments have indicated that students in the pilot program have achieved well beyond anyone's expectations. For example, in 1999-2000, Glastonbury Public Schools was the sole recipient of the AP Regional Award for New England. This award was based on the facts that Glastonbury students had the highest increase in numbers taking the test and the highest increases in individual scores.

Plans are now being made to expand the Physics First program to include students at all achievement levels. Over the next three years, the total science program will take on the curriculum profile outlined in Table 2, providing all pilots are successful and approval is secured from the board of education. There is much optimism in our district about the new science curriculum model and its potential to improve science education for all students.

Kenneth R. Roy is K-12 director of Science and Safety for Glastonbury, Connecticut, Public Schools. He also is an author/columnist for numerous professional publications; he and co-author Malcolm Cheney contributed the article "Teaching in an Equitable—and Safe—Science Laboratory" to a previous issue of ENC Focus *(enc.org/focus/equity). Email: royk@glastonbury.us.org*

Resources

American Association for the Advancement of Science: Project 2061. (1989). *Science for All Americans.* New York: Oxford University Press.

Bardeen, Marjorie & Lederman, Leon. (1998). Coherence in Science Education. *Science*, 281, 178-179.

Lederman, Leon. (1999). A Science Way of Thinking. *Education Week*, 18(40), 1-3.

National Commission on Excellence in Education. (1983). *A Nation at Risk: The Imperative for Educational Reform.* Washington, DC: U.S. Department of Education. Retrieved May 22, 2001: www.ed.gov/pubs/NatAtRisk/title.html

National Research Council. (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

National Science Teachers Association. (1996). *Scope, Sequence, and Coordination: A Framework for High School Science Education.* Arlington, VA: Author.

Physics First Network. Retrieved April 9, 2001: members.aol.com/physicsfirst/

Project ARISE. Retrieved May 23, 2001: www-ed.fnal.gov/arise/arise.html

Integrated Curriculum:

Teachers from across the country share their experience using integrated mathematics curricula that engage students in meaningful real-world problem solving.

by Judy Spicer, ENC Instructional Resources

An integrated high school mathematics curriculum offers an approach to teaching and learning that is vastly different from the compartmentalized mathematics curriculum (arithmetic, algebra, geometry, more algebra, and precalculus-calculus) commonly found in U.S. classrooms. The idea is not new. Major national education groups have issued reports—from the 1893 Committee of Ten Report (see page 20) to NCTM's April 2000 *Principles and Standards for School Mathematics* (PSSM)—that have encouraged greater integration of these subjects. Textbooks that integrate mathematics have been around since the 1920s (*NCTM Yearbook*, 2000, p. 2). Support for an integrated curriculum is strong among leaders in mathematics education (see sidebar on page 25).

The controversy comes not from theory but from practice. The arguments began in the late 1980s and

Teachers Find Success with Integrated Math

The following teachers contributed to this article by responding to email from the author. Our thanks to:

Helen Crowley, Southington High School, Southington, Connecticut

Sandie Gilliam, San Lorenzo Valley High School, Felton, California

Rosalie Griffin, Crosby High School, Waterbury, Connecticut

Jim Kearns, Lynnfield High School, Lynnfield, Massachusetts

Pat McCarthy, Portsmouth High School, Portsmouth, Rhode Island

Barbara MacDonald, North Allegheny Intermediate High School, Pittsburgh, Pennsylvania

Gaby McMillian, Harlandale High School, San Antonio, Texas

Craig Russell, University of Illinois Laboratory High School, Urbana, Illinois

A Driving Force in 21st-Century Mathematics Education

early 1990s, when the National Science Foundation (NSF) funded several major projects to provide models for integrated mathematics curricula. Implementation of these integrated curricula raised objections from those to whom the traditional curriculum was sacrosanct. Disagreement about the integrated curriculum became interwoven with other controversial issues such as cooperative learning, the use of technology, alternative assessments, and the teacher-as-a-guide model of teaching. Thus, the integrated curricula became a focus point of what came to be known as the math wars.

Many critics of integrated mathematics point out that few teachers are prepared to handle that kind of curriculum. Teachers who lack a deep knowledge of the mathematics content may struggle and as a result are accused of teaching fuzzy mathematics. Lack of teacher preparation is the principal reason many school districts hesitate to adopt an integrated mathematics program (*Dialogues*, 2001).

Nevertheless, calls to the publishers of five NSF-funded integrated curricula listed on the COMPASS (Curricular Options in Mathematics for All Secondary Students) web site (www.ithaca.edu/compass/frames.htm) revealed that these programs were used in more than 1,200 schools in at least 39 states during the 2000-2001 school year. Clearly, teachers all over the United States have responded positively to the challenge of teaching an integrated high school mathematics curriculum. They firmly believe in the benefits of showing students that mathematics is an integrated whole and how mathematics relates to the world beyond the classroom.

In researching this article, I corresponded with eight teachers who are finding success with NSF-funded and publisher-developed integrated mathematics curricula. Their enthusiasm contradicts today's embattled math-wars environment.

Re-energized Teachers

A veteran of 35 years of teaching, Rosalie Griffin reports that during the last 10 years she has been re-energized and inspired by a dynamic

What Is Integrated Mathematics?

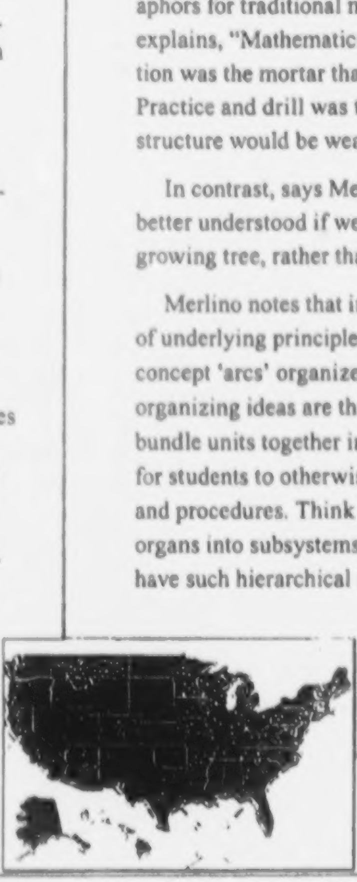
In the January 2001 issue of NCTM's *Mathematics Education Dialogues*, Bob Trammel writes, "Integrated mathematics is not new mathematics but old mathematics taught and assessed in new ways." Using high school mathematics as an example, he goes on to explain that the traditional program is horizontal, with first-year algebra, geometry, and second-year algebra taught in a linear sequence. Integrated mathematics is vertical in that it weaves the three together throughout the program.

In the same issue of *Dialogues*, F. Joseph Merlino views the change from traditional to integrated mathematics curricula metaphorically. Metaphors for traditional mathematics came from the building trades, he explains, "Mathematics was about 'laying a good foundation.' Memorization was the mortar that held the bricks of mathematics facts in place. Practice and drill was the mortar mix. If the walls had too many gaps, the structure would be weak. Going back to 'fill in the gaps' was necessary."

In contrast, says Merlino, "...integrated mathematics curricula can be better understood if we view the act of thinking as a living system, like a growing tree, rather than like a structure made of bricks and mortar."

Merlino notes that integrated curricula develop topics through the use of underlying principles such as function and variable. He writes, "These concept 'arcs' organize daily lessons into large unit ideas. These large organizing ideas are then repeated across the grade levels, serving to bundle units together into 'strands,' thus providing conceptual coherence for students to otherwise disjointed and juxtaposed mathematics topics and procedures. Think of cells organized into tissues, tissues into organs, organs into subsystems, and subsystems into a body. Brick walls do not have such hierarchical integration. The brick on top looks just like the brick at the base."

For more on this topic, visit the Mathematics Education Dialogues *section of the NCTM web site (www.nctm.org/dialogues/2001-01).*



Sites implementing NSF-funded integrated mathematics curricula in 2000. Image used by permission of COMPASS.

integrated curriculum that provides challenges for all students. Griffin notes, "The changes that occurred from using this curriculum were beyond our expectations. Not only did student grades improve, but we also received feedback from students that they finally understood math and could see how it was used in real life."

The curriculum Griffin uses begins each unit with a real-world word problem that "really engages students and makes math relevant to daily life. The use of the graphing calculator made math come alive and provided the power of visualization of what had previously been presented as a system of symbols that were abstract and meaningless to students."

She continues, "The thematic threads that weave through the curriculum push students to look for patterns, make conjectures, and validate findings. This process enables students to develop higher-level reasoning skills and to become critical thinkers."

Barbara MacDonald, mathematics department chair with 27 years of experience, enjoys the student engagement: "Use of real life data allows for interesting discussions. An integrated curriculum also causes our students to think more. The hands-on activities make it more difficult for students to just sit."

In only the second year using the integrated program, Jim Kearns, department head for math, science, and technology at his high school, is enthusiastic, "Students who didn't have an understanding of what slope was in the old curriculum are now describing angle measure by the slope. They are making connections that I thought were beyond them."

The Challenges

Change is difficult for everyone involved—students, parents, and teachers. Yet, even as the teachers recognize the challenges, their focus is on the benefits.

For students, sometimes those who are most successful with traditional mathematics programs face the greatest challenges with the new. Sandie Gilliam, National Board Certified Teacher and winner of the Presidential Award for Excellence in Mathematics Teaching, explains: "What I find is that for the students who have previously learned (or so they think) to follow the teacher's directions, do 20 practice problems, and memorize for the test, doing the integrated program actually is harder for them. Instead of thinking deeply into the mathematics to conceptually understand what mathematically is happening, they feel that the mimicking approach is actually easier. An integrated program is the best for all students, just like eating vegetables is very healthy for humans. Many humans hate vegetables and neglect eating them. In the end, it is their body's health that suffers."

Jim Kearns admits, "The students have had a difficult time transitioning to the new curriculum series since they were used to memorizing simple procedures, doing multiple practice problems, and taking tests and quizzes on a small selection of topics."

Sometimes parents resist the change, notes Helen Crowley. "This curriculum doesn't look like 'real math' (i.e., the algebra we used to memorize when we were in school) to parents. It is difficult for many parents to help their children because they can't find problems in the book that show them how to do the problems we assign. Also, some tutors find it difficult to tutor students because they have not been exposed to this type of curriculum before."

Gaby McMillian, a teacher with 10 years experience, describes the challenges faced by teachers, "Pretty much everything had to change. We had to change our role in the classroom from in-front lecturer to classroom facilitator. We had to learn to incorporate technology, specifically the graphing calculator. We had to manage groups, lead whole-class discussions, change our questioning techniques, change our ideas about assessment, change our ideas about how students learn, change our expectations of their capabilities—and work harder!"

Helen Crowley says, "The real challenge to teaching this way is that you must be very familiar with the material and willing to risk having students take you in a direction other than the one you had planned for the lesson. This is also the most exciting part of using the curriculum because we are really doing math more often, as opposed to pushing around numbers and variables."

"Our teachers needed to learn more mathematics," says Barbara MacDonald. "We needed to work together to explore different topics. The integrated curriculum forced teachers who taught predominately algebra or geometry to combine skills. Yes, it takes more work to make the transition, and yes, I am sure some teachers would like to return to a traditional program. However, in working through the challenges, our teachers have become a more cohesive staff with common goals."

The Payoff

Despite the challenges of making the change, the teachers feel that the integrated curricula are making it possible for them to meet two tightly intertwined goals—helping all students achieve mathematics success and demonstrating that success on high-stakes assessments.

JUMP ONLINE!

For information about the five NSF-funded integrated high school curricula, go to the COMPASS (Curricular Options in Mathematics for All Secondary Students) web site (www.ithaca.edu/compass/frames.htm).

Additional information about mathematics curricula is available on the web site of the U.S. Department of Education Math and Science Education Expert Panel, Exemplary and Promising Mathematics Programs, 1999 (www.enc.org/professional/federalresources/exemplary/promising/documents/0,1944,CDS-000496-496,00.shtm)

Connect to all web sites mentioned in this magazine via the online version (enc.org/focus/horizons).

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Sandie Gilliam comments, "For the gifted students, who by nature may want to know why things are happening and how formulas or equations develop, this program enables them to get deeper into the mathematics than they would in a traditional program. For the lower-level students who need a hands-on approach and real-life problems in mathematics to work with, this program best serves their needs."

Mathematics department chair at the University of Illinois Laboratory High School, Craig Russell reports, "I see an important benefit to those strong math students who are committed to lots of nonmath activities (music, sports, hobbies) and who tend to race through homework assignments. The integrated curriculum makes those students slow down and think about the problem setting and actually problem solve (the way adults solve problems) by trying to decide which tools to use."

Gaby McMillian says, "Right now we are seeing a huge increase in the number of students who opt for the pre-AP course and in the number enrolling in upper-level classes. We have gone from only seven students in AP Calculus to 32, and from 19 students in AP Statistics to 99 for the 2001-02 school year."

McMillian goes on, "All our test scores have gone up. We are seeing much better understanding of math concepts, as well as retention. Reading is better. 'Word problems' are so much a part of what students do daily that there is no struggle against them."

Pat McCarthy, a teacher with 12 years experience, observes, "Because scores for our general math population were low, we were looking to provide a curriculum to help boost scores at that level. These students are now taking four years of math. We had a couple of these students take the SAT this year—that never happened when we had just general math."

"As we analyzed the 1998 and 1999 results of our state tests, we

Expert Support for Integrated Mathematics

An integrated mathematics curriculum was recommended in NCTM's 1989 publication *Curriculum and Evaluation Standards for School Mathematics.* This document called for a core curriculum to be offered as the first three years of high school mathematics. The goal for the core curriculum was to avoid the tracking of students into either college preparatory or general mathematics sequences based on narrow perceptions of performance or curricular goals. Traditional curricular expectations of memorizing isolated facts and procedures and becoming proficient with by-hand calculations and manipulations were to give way to developing mathematics as a connected whole with an emphasis on conceptual understanding, multiple representations and their linkages, mathematical modeling, and problem solving.

The Curriculum Principle in NCTM's *Principles and Standards for School Mathematics* (PSSM, 2000) states: "Mathematics comprises different topical strands, such as algebra and geometry, but the strands are highly interconnected. The interconnectedness should be displayed prominently in the curriculum. A coherent curriculum effectively organizes and integrates important mathematical ideas so that students can see how the ideas build on or connect with other ideas to enable students to develop new understandings and skills." (p.15)

The January/February 2001 issue of NCTM's *Mathematics Education Dialogues* explored the issue of integrated curriculum with a look at mathematics education from an international perspective. U.S. students' poor showing on the Third International Mathematics and Science Study (TIMSS) has brought into question the entire U.S. approach to mathematics education. In *Dialogues*, Hugh Burkholder observes: "The main advantages of integrated curricula are that they build essential connections, help make mathematics more usable, avoid long gaps in learning, allow a balanced curriculum, and support equity. I know of no comparable disadvantages, provided that the 'chunks' of learning are substantial and coherent."

In the same issue of *Dialogues*, Lynn Richbart reflects on his involvement in the development of an integrated mathematics curriculum in New York State 25 years ago. He believes that "the integrated mathematics program has come of age. The program lends itself to a problem-solving approach taken by many of the newer National Science Foundation programs. Even most of the more traditional algebra textbooks of today integrate mathematical reasoning, geometry, probability, and statistics topics." Richbart further recalls, "We believed that an integrated program made sense. It allows a broader view of mathematics and at the same time saves time by teaching similar concepts of algebra, geometry, trigonometry, probability, and statistics together. It also permits much more practical applications to be shown."

noticed that we had a population of students who failed," says Jim Kearns. "These were the students who entered high school without completing algebra in grade eight. For both of these exams, 100 percent of these students failed. We felt that the traditional approach was not working. After we instituted our integrated curriculum, these same students found the state test reasonable. Just to have that feeling of confidence in their math ability is a change from the notion that they cannot do mathematics."

Rosalie Griffin describes the situation in her inner-city high school: "When I was named math department chair in 1990, one of my major concerns was to address the high failure rate of 'lower-level' students enrolled in our two-year Algebra I course. If a change in curriculum could make a difference, this group would surely be the test. My inner-city school has struggled with the challenge of raising test scores especially on the Connecticut Academic Performance Test (CAPT) given to all sophomores. With the second group of students using integrated curriculum, the top two scores in math on the CAPT were from our students. Quite an achievement!"

According to Craig Russell, the benefit of an integrated curriculum for state-mandated testing depends on the testing program: "High-stakes tests in some states gear mathematics portions toward problem solving, with rubrics supporting thought process as well as skill development. To the extent that that kind of testing becomes prevalent, integrated curricula are well suited to preparing students for the tests without having to teach to the test. The opposite would be true for high-stakes tests focusing on low-level factual knowledge and rote skill demonstration."

Gaby McMillian concludes, "I used our results on our state test to argue for integrated mathematics. The test is becoming increasingly challenging. It is also being written to defy short-term test-taking strategies. A student must have a deeper understanding of the math and a larger toolbox of skills and problem-solving strategies."

Former high school mathematics teacher Judy Spicer is senior mathematics abstractor for ENC and a frequent contributor to Focus. *Email: jspicer@enc.org*

References

National Commission on Mathematics and Science Teaching. (2000). *Before It's Too Late*. Washington, DC: U.S. Department of Education.

NCTM. (1992). *Curriculum and Evaluation Standards for School Mathematics, Addenda Series*, Grades 9-12. Reston, VA: Author.

NCTM. (1989). *Curriculum and Evaluation Standards for School Mathematics*. Reston, VA: Author.

NCTM. (January/February 2001). *Mathematics Education Dialogues*. Reston, VA: Author.

NCTM. (2000). *NCTM Yearbook: Learning Mathematics for a New Century*. Reston, VA: Author.

NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

Stigler, James W. & Heibert, James. (1999). *The Teaching Gap*. New York: Free Press.

An Interview

Handheld Technology: An Essential Ingredient in Teaching and Learning Mathematics

Handheld computers that can solve equations with the push of a button naturally raise questions about what and how we teach mathematics. This educator believes this technology may be the key to richer mathematics content.

by Terese Herrera, Instructional Resources, ENC

To anyone who has known Bert Waits, the topic "New Horizons in Mathematics and Science Education" brings his name immediately to mind. He and Frank Demana, professors of mathematics at The Ohio State University, were among the first to realize how technology would inevitably impact the math curriculum and how it could enhance classroom instruction.

Together they wrote textbooks that incorporated technology as a basic tool in problem solving and in mathematical understanding, rather than treating it as an add-on. In 1988, they founded T^3 (Teachers Teaching with Technology), which began as local training in the use of graphing calculators and has grown into the world's largest professional training program focused on handheld technology in the classroom. Together and separately, Waits and Demana have been speakers at numerous national and international conferences. In 1997, the pair received the Glen Gilbert Award from the National Council of Supervisors of Mathematics (NCSM).

Currently, Waits is a professor emeritus of mathematics at The Ohio State University, member of the board of directors of the National Council of Teachers of Mathematics, a consultant for Texas Instruments, Inc., and a textbook author for Addison-Wesley/Prentice Hall. Beyond these professional titles, he is known as a leader on the front lines of progress and excellence in mathematics education.

Before we talk about integrating technology, what do you see as the big issues for the future in teaching math and learning math?

There are two very serious societal issues that affect math teaching across the board. One is the fact that what society expects from teachers is not congruent with how

with Bert Waits

teachers are treated and paid. Society—be it the media, government officials, business experts, or futurists—tells us that the fate of the country rests on properly educating our children. Yet we don't treat educators as professionals. We don't treat educators with respect, and we certainly don't pay them wages that are commensurate with the importance of their charge.

Related to that issue is the fact that so many teachers are underprepared in mathematics and science knowledge and to some extent in pedagogy. Too many math and science teachers are teaching outside their majors or even outside their certified areas. We need to find better ways to provide professional development and ongoing support for teachers.

At the same time we need to attract new teachers and to keep them in teaching. I heard a startling figure recently—that we lose around 30 percent of our new teachers in their first three years on the job. I suspect the 30 percent we lose are the best teachers. I also suspect they leave for reasons that I mentioned—lack of respect, low pay, and so forth. This situation has to change, fundamentally and systemically, or we are going to become a second-rate country. I am very, very fearful of our future in the next 50 years if we don't address these critical issues.

The Technology Principle

Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.

—Principles and Standards for School Mathematics

How do you think the content of school mathematics will be changed when technology is integrated into classroom instruction?

Very positively, I think. Here is a picture I am trying to paint. The math content that we teach has evolved over time to serve society. Mathematicians have always used the tools that were available in their time. Logarithms, for instance, were invented to help in arithmetic computation and became a tool for doing calculations. Had calculators been available then, scientists and educators would have used them because they would have been better tools.

The mathematics of computation (including arithmetic computation and algebraic symbolic manipulations in algebra and calculus) is profoundly influenced by current technology. Yet some think we should hold the curriculum constant, ignore changes in technology, and teach only what we taught 50 or 100 years ago. That is ridiculous. It's like trying to practice medicine without the benefit of new advances in drugs and techniques.

Not all of the mathematics curriculum should change in response to technology. Besides the purely computational, there is the mathematics that consists of reasoning, conceptual understanding, theorems and proofs, applications, and problem solving. Student use of technology will provide more time for doing richer mathematics. Technology has even affected pure mathematics in amazing ways. For example, technology has opened new mathematics content for study, such as Mandlebrot's work with fractal geometry.

What effect will technology have on computation?

History tells us that any mathematical content that deals with computation will change due to technology. The most recent lesson of history is what the scientific calculator did to the kind of computation that I taught from 1961 to 1976. In a few short years, the scientific calculator made some of the mathematics content that I taught at the university level simply obsolete. For us to fail to understand why that happened is foolish. It happened simply because the scientific calculator was a better tool—a better way to compute.

The same thing is going to happen soon with even a greater body of traditional mathematics. Computer algebra systems (CAS) will radically change the content of algebra and calculus as we know them now. We are in the beginning phase of that change. In 20 to 25 years, many of the paper-and-pencil manipulations that we teach today will be viewed by most people as obsolete as the slide rule.

But today many people are concerned about discarding methods that have long been the standard ways to do math. What would you say to them?

By looking in my lecture notes and the textbooks I used in the 1960s, I can prove to you that 25 percent of my old college algebra course *disappeared* because of the scientific calculator. Look, nobody is poorer because we no longer teach students how to extract square roots by hand. It is inevitable that many paper-and-pencil techniques taught today will simply disappear, and nobody is going to be the poorer for that.

Let me clarify this. Some educators say that a topic like factoring will become obsolete because of technology. Nothing could be further from the truth; it upsets me when I hear such talk. Teachers need to understand that factoring is part of the Fundamental Theorem of Algebra. The concept of factoring will *always* be very important. But the tools we use to factor will change. Technology is a new tool that can be used to factor, in addition to factoring mentally or with paper and pencil. Technology allows students to master the concept and helps provide deeper understanding. When we have new technology tools, we should not be afraid use them. Factoring will not become obsolete, but some methods used in factoring might very well become obsolete. It's an important distinction to make.

You've often mentioned a need for balance. . .

Being a conservative old guy, I very much believe in balance. Even though I am an advocate of appropriate use of technology in the teaching and learning of science and mathematics, I also believe that the teaching (and testing) of computational *mental skills* is more important than ever. Technology provides a convenient tool for computation, but it needs to be applied correctly. For example, when a student uses a calculator to compute 14.5 percent of $1,500 and finds the answer is $21,750, he must recognize that something is terribly wrong! Such understanding comes from *mental computational skill* and the ability to estimate. (The answer should be less than 20 percent of 1,500, or 300 computed *mentally.*)

I also believe that there is an important role for paper-and-pencil manipulation. For example, before students use a handheld graphing device in middle school or high school, they should spend lots of time with graph paper and tables—plotting points, connecting points—understanding that process first. Similarly, before students use a computer algebra system, they should have some understanding of simple paper-and-pencil algebraic manipulations. This is far different from requiring paper-and-pencil manipulation *all* through high school and *all* through calculus. Thus, I am saying balance, balance, and balance.

It seems that we hear your voice more often than others advocating technology. Is this because not many others are speaking out?

That's true. The people who oppose the integration of handheld technology in the teaching and learning of mathematics are no doubt well intentioned, but they are simply harming our children. These people deny our children the best education because they are not allowing children to benefit from the advances in teaching that technology has created. They are promoting an unbalanced curriculum in that they think the only way students should learn mathematics is "drill and kill" with pencil and paper.

Again, I want to stress the need for a balanced curriculum. We should *increase* computational mental skill requirements and mental estimation skills. I certainly think that there is a strong role for paper-and-pencil manipulation at appropriate stages in the curriculum, *but* I also want the role of technology to be recognized as one of the essential ingredients in the teaching and learning of school mathematics.

How can we bridge between paper-and-pencil algebra and computer algebra?

There will be *pedagogical* computer algebra systems developed that will bridge the gap between using computer algebra as a computational tool and using no computer algebra at all. For example, using the TI-92 Plus or Derive software (Texas Instruments), or Mathematica (Wolfram Research), you can solve an equation by pressing one button. I call that a "black-box" process: equation in, press a button, solution out. This is a way for students who have already mastered the concepts to bypass number crunching and go immediately to the bigger issues—Did I really solve the problem? What does the solution mean? and so forth.

Currently under development are *pedagogical* computer algebra systems that require students to tell the machine what steps to apply as they solve an equation. The student drives the process. It's an intermediate step between paper-and-pencil only and black-box computer algebra solutions. At least for now, I believe such systems will serve as a bridge to help teachers develop strategies to use computer algebra effectively in their teaching. The Texas Instruments version of the new system, called the *Symbolic Math Guide™*, is available free as a concept application for the TI-89 or TI-92 Plus.

Earlier, you called technology an essential ingredient in teaching mathematics. Could you explain?

I very much believe in the new *Principles and Standards for School Mathematics* (NCTM, 2000). The Technology Principle from this document says, "Technology is *essential* in teaching and learning mathematics." It is *essential*!

Technology affects both content and teaching. Technology can provide significant pedagogical enhancements to the teaching and learning of science and mathematics. As a pedagogical tool, the graphing handheld, as I call this device, is used to provide a multiple representational approach. You can view a problem analytically with paper and pencil; you can view it visually using a graph; you can view it numerically using tables. Thousands of teachers using graphing handhelds can attest to the power of this approach.

In teachers' undergraduate math courses, we need to model the mathematics of today, where there is full integration of technology and full appreciation of the power (and limitations) of technology. Appropriate use of technology is an essential part of a balanced curriculum. Some university math departments resist this tooth and nail when teaching preservice teachers. This is a very unfortunate situation.

What would you say needs to happen before technology becomes an integrated and effective part of math teaching?

Far too many teachers have a limited understanding of how technology can be used appropriately in their teaching and how technology will affect and change the content of math and science. We need significantly more professional development opportunities that focus on such issues and a strong commitment to making integrated technology a reality.

How do you see that happening?

We have to put much more money and effort into understanding the need for professional development for teachers. Parents, legislators, our society in general, have to commit to the fact that meaningful, ongoing professional development is necessary and fund it in appropriate ways, including providing release time.

In summary, what is your vision for the future?

Handheld technology and desktop PC technology are merging. It started back in the mid-80s with the Casio 7000, the first graphing handheld. Every couple of years you see more and more evidence that the desktop or notebook PC and the handheld graphing devices are merging. These devices are now handheld computers. You may have noticed that I avoid using the word "calculator." We can purge the word "calculator" from our vocabulary and replace it with "handheld computers."

We are going to see more of the vision for computer technology that educators had ten years ago. Do you remember the big push for networked computer labs? Few schools could deliver on that promise due to the practical barriers. Computer labs were expensive; it was hard to get kids to the labs; computers weren't portable. Now schools are using handheld computers that allow *any* classroom to become fully networked. Further, students can take the handhelds home to do problem explorations and then report and collaborate as a class. Teachers can transmit a set of problems, see how each student is solving the problems, and give immediate feedback. (Editor's Note: See page 30 for a classroom example.)

To sum up my vision for the future: many of the computational and symbolic manipulative techniques in algebra and calculus will disappear. As a result, we will see more class time available for teaching real mathematics—understanding, reasoning, and problem solving. In addition, we will have more time for activities that show the beauty and utility of mathematics. We'll have more time to look at mathematics that used to be considered inaccessible but is now accessible because of technology.

In a few short years, students are going to be walking around with portable computers that will be inexpensive, handheld, networkable, crosscurricular, and Internet accessible. Students will be able to work together and get real-time feedback on their progress. Learning will not come in the lecture-and-recitation format that you and I experienced. A truly networked classroom is going to provide a dynamic learning environment where all students can participate, demonstrate understanding, and master concepts. It's going to be *student*-centered learning. This is where we are going, and I, for one, am extremely excited about it!

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Photos pp 28 and 29 by Molly Winkelman

Piloting the Navigator

Math teachers take new classroom technology for a test drive.

by Laura K. Brendon, ENC Information Services

For the past three years, James Kozman, chair of the Mathematics Department for Franklin Heights High School in Columbus, Ohio, and his colleagues have been piloting the Texas Instruments (TI) Navigator™ system. The system consists of clusters of three or four TI-83 Plus graphing calculators plugged into network hubs, which are, in turn, connected by radio signals to a computer on the teacher's desk. By high-speed Internet connection, the teacher's computer communicates with a server at the company's headquarters in Dallas.

When the company first approached him, Kozman remembers that the engineers showed him some basic ideas, but they didn't really know what teachers might accomplish with the technology. They invited the Franklin Heights teachers to dream. "So we started to dream," reports Kozman.

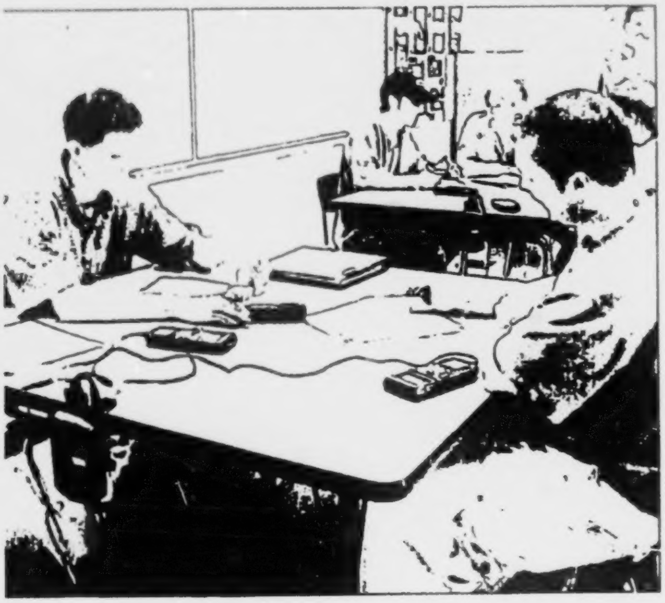

Photo by James Kozman

The teachers brainstormed ideas for using the system in their classrooms. They started by focusing on questions such as "Why would a teacher want to use this system? What could we do with it to make our classes better or more interesting?"

To answer these questions, they had to pinpoint some of the limitations of their present practices. The teachers identified three: textbooks provided a limited number of practice problems, students might have to wait a day or more to find out if they had worked problems correctly, and everyone's answers were public to the rest of the class.

Overcoming Limitations

While the company plans to provide a database of activities, the Franklin Heights teachers currently create their own by programming the calculators. One of the teachers' first designs was an interactive program in which algebra students could practice computing the slope of a line. "A lot of our early programs were drill and practice," Kozman says, but those programs addressed the teachers' first concern by increasing the textbook's limited number of exercises.

Since the early trials looked promising, the department began to dream more broadly. One result was that Douglas Roberts, a math and computer science teacher who has been designing the department's programs throughout the test period, programmed software that randomly assigned problems to students. His intent was to prevent students from copying each other's work. The unintended result was that students began to collaborate with each other on problems, stay on task in the classroom, and engage with the lesson. "Cooperative learning was an offshoot of the random generator," Kozman reports.

The changes also addressed the other two limitations the teachers had identified at the start. The system lets the students know right away if their answers are correct or incorrect and allows teachers to see how students are doing. The students are more inclined to take risks because their answers are anonymous to their peers, even when projected on a screen before the class. Roberts found that department members' teaching methods changed: "We can make modifications to lessons on-the-fly because we get immediate feedback…we can adjust to students."

One of the most important results, according to Roberts and Kozman, is how the new techniques changed the students' attitude toward mathematics. "It got kids fired up about math and wanting to do more. They are intrigued by technology." The teachers believe this could possibly be attributed to the similarity between the calculators and the handheld games the students know so well. Kozman reports his shock "the first time a ninth-grade student finished his 10 problems and asked for more."

Moving Beyond

The math department soon moved beyond resolving the issues they had initially identified to designing classroom materials that cannot be presented without technology, that allow for immediate feedback, anonymous reporting, and database support. Teachers now ask themselves "how can I use the system to help me and my students?" Kozman calls this a "fork in the road."

Franklin Heights is looking toward the time when it can collaborate with other schools to run experiments so all can gather, share, and manipulate large data sets. Roberts' computer classes are building some of the new programs. Kozman believes other disciplines could easily use similar interactive systems that allow for immediate feedback, anonymous interaction, and sharing of data.

Roberts' advice to any teachers who develop technology-based tools for their classroom is to "have patience! On any given day, it's not going to work…for bizarre reasons. Try something else and go on…. Take little steps…. Be creative—think outside the box!"

He cautions that teachers choosing technology should ask questions up front; find out who will support the equipment and who will do the development. Above all, Kozman adds, teachers should be prepared to change. Technology "will force teachers to rethink their teaching and lessons. Teachers will need to ask, 'How do I modify my lessons to take advantage of the technology?'"

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Handheld Computers for Classroom Use

The TI-Navigator system described in this article builds on technology that is already in the hands of students and teachers. Many students own their own TI-83 Plus graphing calculator or have access to school-owned calculators. The new system connects the calculators to the teacher's computer, allowing students and teachers to beam questions and answers to each other. The company expects to market the product as classroom and student kits, which will give schools Internet access to the system's online functionality and curricular materials, an access point for transmitting data to and from the network hubs, the network hubs, and recharging apparatus for the hubs. For more information, visit the web site (education.ti.com/product/tech/tinav/features/component.html).

Schools are now using other types of small, specialized computers for a multitude of purposes. Here are just a few examples:

- Putnam City Schools in Oklahoma (www.putnamcityschools.org) use Palm computers with probes for science classes. The Palms' portability means that students take and store measurements such as light levels, acidity, and temperature in the field (www.palm.com/education/palmED). Web sites that support Palm education software include Palm Applications in Education (pie.concord.org) and ProbeSight (probesight.concord.org).
- Students attending the Ina J. Mead School in Allen Park, Michigan, also use Palm handhelds. Summer school science students use software developed for the handhelds by the University of Michigan's Center for Highly Interactive Computing in Education, Hi-CE (hi-ce.org).
- American literature students at Chicago's Highland Park High School (www.d113.lake.k12.il.us/hphs) store works of several authors on goReader computers (www.goreader.com). The computers let students take notes, read texts, write papers, and browse the Internet. Their teacher marks and highlights texts before the files are loaded on the computers.
- Students in Hanahan, South Carolina, Middle School (www.berkeley.k12.sc.us/Middle/HMS/HMS.htm) use handheld computers supported by Mindsurf Networks to search the Internet and write reports. The devices hold general application software such as Microsoft Word and Excel (www.mindsurfnetworks.com/pc/).

References

Lawrence, Catherine. (5 April 2001). 32 Hanahan Students Get Handheld Computers. *Post and Courier.*

Picket, Debra. (26 June 2001). Shelve Those Textbooks: Handheld PCs for Students. *Chicago Sun-Times.*

Putnam Schools' Palm Use Praised. (16 May 2001). *The Oklahoman.*

Science Class Gets Boost. (23 July 2001). *The Detroit News.*

New Horizons in the News, 2001

ENC can help you keep up to date on the latest educational issues. Here's a brief overview of what's recently appeared on the horizon that may impact your school.

by Carolyn Hamilton, ENC Publishing

Horizons are about as far as we can see into the future. Even then, some things that loom large on the horizon dwindle to little or nothing as they come closer. What appears to be a speck may inflate and grow.

As I write this on a warm day in June, the education horizon is cluttered with hefty reports, new movements, reform proposals, promises, and innovations. And hanging over everything on the horizon is computer-related technology. Some of these trends, movements, and events are outside the classroom now, but they show promise of impacting our work over the coming months.

The good news for anyone who sees a confusing horizon in these headlines is the fact that classroom teachers are aware and active in all of these arenas. They are collaborating with others who are pushing the horizon to find better methods of teaching mathematics, science, and all the other subjects, whether the material is taught electronically to hundreds or at the desk of one child.

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Closing the Digital Divides

Connecting classrooms to the Internet, which was a goal on the horizon only a few years ago, has become a reality in many school districts. In 2000, about 94 percent of the schools had Internet access, and in those schools about 80 percent of the classrooms were connected (*Atlanta Journal-Constitution*, May 10, 2001). According to the NetDay Foundation, the focus has shifted from wiring schools to making use of the technology (*New York Times*, April 4, 2001). Many forces are working together to encourage greater use of technology in the classroom. For example:

- Michigan, Missouri, Oregon, Virginia, and Washington are connecting all schools and community colleges to Internet2, which is about 1,000 times faster and accessible to education groups via a network called Abilene (www.internet2.edu/abilene/html/about.html). Students and teachers will have access to experiments and research data at some 200 research facilities and universities. (*Seattle Times*, April 3, 2001).
- Pennsylvania challenged school districts to submit plans for transforming themselves into "digital school districts." Three districts won grants of up $2 million each. The state hopes the three will be models for other districts (*Philadelphia Inquirer*, February 23, 2001).
- Arizona has a five-year plan to provide broadband Internet access for rural communities. Schools, libraries, and other government bodies will purchase telecommunications services from carriers who have contracts with the state (*Digital Divide Network*, April 25, 2001).
- Faster, more powerful Internet technology is being employed to deliver assessment tests to schools and return the results quickly. South Dakota, Oregon, and Virginia are taking their first steps in testing online. A spokesman for Educational Testing Service called these efforts the beginning of an evolution toward online testing throughout education (*Education Week*, May 23, 2001).
- The manufacturers of computer-related equipment also look for ways to help teachers use technology in the classroom, often with an emphasis on math and science. IBM offers customized lesson plans in math and science online (K12ndes.watson.ibm.com); Microsoft and Intel jointly sponsor training for K-12 teachers on how to use technology in the schools. Casio works with Clemson University and the University of Dallas to offer workshops, aligned with state standards, for math and science teachers (*PR Newswire*, April 6, 2001).

Wired and Wireless Classrooms and Homes

While the means of connecting to the Internet become ever faster and more powerful, computer devices are becoming smaller and less expensive. It is not unusual for school districts to provide the laptops and handheld devices that students carry to and from school.

- Hillsborough County in Florida, which includes Tampa, made the national headlines with its $50-million, five-year contract with Compaq, making that company the sole provider of computers and technical services. Parents too can purchase the company's computers at reduced prices (*Education Week*, May 2, 2001).
- Henrico County, Virginia, also made headlines by placing an order with Apple Computer to lease 23,000 iBook laptops, enough for every teacher and student in middle and high schools (*New York Times*, May 8, 2001).
- Celebration School in Celebration, Florida, has issued wearable computers to its students. The iButton can be embedded in rings, tags, or watches. Along with giving students access to buildings and classrooms, the iButton can open web pages from any computer on the school intranet or home Internet (Dallas Semiconductor News Release, March 17, 1999).

Online Classrooms

Distance learning and at-home learning have taken on new meaning with the proliferation of virtual classrooms sponsored by a variety of organizations. (See article on page 53 for more on this topic.)

- One of several high schools on the web, the Virtual High School (vhs.concord.org) was developed by the Concord Consortium with collaborating schools, corporate sponsors, and a grant from the U.S. Department of Education. Open around the clock, every day, the school offers the core subjects, technology, and foreign languages for grades 9-12 and graduate-level professional development for teachers. Participating schools contribute courses and in turn earn "seats" in other classrooms for their students. Two hundred schools in 28 states and the District of Columbia have students enrolled in VHS's 156 courses.
- All high school students in Florida, including the home-schooled, can enroll in courses offered by Florida Online High School, sponsored by Jones Knowledge and IBM (fohsseminar.jonesseminarknowledge.com/info.html). The online school also markets its services, including consultation, nationwide (*St. Petersburg Times*, May 7, 2001). .
- Any student in Kentucky can enroll in courses, from basic to advanced, in the statewide Kentucky Virtual High School (www.kvhs.org/). The state also has a virtual university.
- An Ohio-based group is designing an online charter school for K-12. Virtual Community Schools of Ohio will include charter enrollees, the home-schooled, and dropouts. Students will receive a computer, a printer, and a fax machine (*Columbus Dispatch*, April 20, 2001).
- Online learning is not just for teenagers. The University of Maryland and Frostburg State University offer an online program for teacher recertification. With a grant from AT&T, the universities offer coursework in updating teacher skills and focus on reading, science, and math (University of Maryland University College, February 28, 2001).
- The New School University in New York City is planning an online certificate program in teaching with technology. Classroom Connect offers training and continuing education credits through its web-based Connected University. Courses can be applied to degree programs at some universities. Jones International University has launched an online master's degree program in education (*New York Times*, April 25, 2001).
- In spring 2001, the Massachusetts Institute of Technology (MIT) announced that it would make the raw course materials produced by instructors available to all on the web. The announcement demonstrated the Internet's potential for bringing quality learning resources to students everywhere (*USA Today*, April 4, 2001).

Smaller High Schools

Several decades ago, the notion that small high schools should be consolidated into one or more large buildings was on the education horizon. The idea took hold; new high schools housed hundreds, sometimes thousands, of teenagers. Today, the big cities are taking the lead in dismantling the large schools and creating small learning communities or separate schools.

- Chicago has created 150 small schools; New York has at least 38.
- Foundations are taking an interest in the move to smaller schools. The Gates Foundation supports the effort in California (*San Francisco Chronicle*, April 1, 2001).
- In St. Paul, Minnesota, funding from the Gates Foundation will let the city school board put about a third of its ninth graders in small learning clusters. Minneapolis is using a McKnight Foundations grant for a similar program (*Star Tribune*, March 20, 2001).

- Some Indiana high schools are taking part in a pilot program to create learning communities or career academies within their large buildings. The smaller units will focus on career themes (*Indianapolis Star*, March 27, 2001).

Global Teacher Recruiting

The current teacher shortage was forecast sometime ago; now it is looming large on the horizon. Faced with shortages in many subjects but especially in mathematics and science, recruiters now search worldwide.

- New York City recruiters hired 125 math and science teachers from Austria alone. Chicago recruited in 28 countries and found 71 teachers. Cleveland hired 50 new math, science, and special education teachers from India (*The Plain Dealer*, March 22, 2001).
- Philadelphia and Newark also recruited in India. Houston went to Moscow in addition to its trips to India (*Philadelphia Inquirer*, March 26, 2001).
- Private placement groups help school recruiters find overseas locations where likely candidates for U.S. teaching positions exist. Sometimes the company is the official employer of the teachers and contracts with the school districts. The teachers enter this country on a special visa (*The Plain Dealer*, March 22, 2001).

Charter Schools and Parental Choice

Public education's monopoly on state and federal funds appears to be weakening as lawmakers look for ways to give parents a choice of schools. The charter school concept is gathering strength with more than 2,000 schools in operation, according to a survey by the Center for Education Reform (2001).

- In Arizona, 249 approved charters are operating schools at 401 sites. According to the Goldwater Institute (2001), more than 6 percent of Arizona's public school students have chosen to attend a charter school.
- For-profit groups have entered the charter school movement. Edison Schools, the largest private operator of public schools, now operates 24 charter schools.
- Some for-profit charter schools are designed to appeal to certain values held by parents. National Heritage Academies promises to teach students how to be good citizens at its 22 schools. The SABIS School Network, with schools in Jordan, Egypt, Lebanon, the United Kingdom, and the United States, emphasizes the international character of its teaching (*Consumers' Research Magazine*, January 2001).
- From its beginnings as a for-profit childcare provider, Nobel Learning Communities now operates 168 schools, including schools for special-needs children, and has Internet linkage with private schools in China (*Christian Science Monitor*, March 21, 2001).
- As charter schools proliferate, some states are looking at legislation and regulations designed for this unique type of institution. Minnesota, the pioneer of the charter school movement, is considering a state board of charter schools to provide oversight (*Education Week*, May 2, 2001).
- Some states are studying the idea of charter colleges such as St. Mary's College in Maryland, which receives a lump sum from the state but is exempt from most controls. The school agrees to meet performance measures. (*Chronicle of Higher Education*, November 3, 2000).
- As newly empowered consumers of K-12 education, parents are the targets of marketing campaigns by for-profit and nonprofit charter schools as well as by the public schools. Some public schools advertise with glossy brochures, contests, and TV infomercials (*New York Times*, April 20, 2001).
- Home-schooling families have become an important factor in the education mix. More than 1.5 million children, or about 3 percent of all students, are taught at home (*Seattle Times*, June 15, 2001).
- Home-schooling parents have formed their own educational associations to represent their interests and concerns, such as access to public school facilities, special education programs, and athletic teams (*Washington Post*, May 10, 2001).
- Half a dozen states have proposals to require home-schooled students to take state assessment tests (*Detroit News*, May 10, 2001).

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References

All news stories on this list appeared in 2001 unless otherwise noted.

Atlanta Constitution, May 10, Digital Divide Narrows, But Some Students Left Behind. Retrieved May 10: www.accessatlanta.com/partners/ajc/epaper/editions/thursday/news_a3af92dba135a1e900fc.html

Center for Education Reform, Survey of Charter Schools, 2000-2001. Retrieved June 28: edreform.com/charter_schools/report/survey01.html

Christian Science Monitor, March 21, Schools to build ties with China by Marjorie Coeyman. Retrieved March 21: www.csmonitor.com/durable/2001/03/20/text/p15s2.html

Chronicle of Higher Education, November 3, 2000, Movement to Create Charter Colleges Gathers Supporters—and Critics by Sara Hebel. Vol. 47, No. 10, pp. A31-A34.

Columbus Dispatch, April 20, Reynoldsburg School District May Join with Online School by Donna Glenn. Retrieved April 20: www.dispatch.com/news/news01/apr01/667537.html

Consumers' Research Magazine, The promise of for-profit primary education. January, Vol. 84, No. 1, pp. 10-15.

Dallas Semiconductor News Release, March 17. Retrieved May 14: www.dalsemi.com/news/pr/product/1999/celebration.html

Detroit News, May 10, Parents fight state bid to test home-schoolers, by Craig Garrett & David Shepardson. Retrieved May 10: www.detnews.com/2001/schools/0105/10/a01-222638.htm

Digital Divide Network, Arizona's 100 Million Dollar Plan for Rural Broadband Deployment, by Kade L. Twist. Retrieved April 25: www.digitaldividenetwork.org/content/stories/index.cfm?key=134

Education Week, May 2, Challenges to Charter Laws Mount by Jessica L. Sandham. Retrieved May 10: www.edweek.org/ew/ewstory.cfm?slug=33charter.h20

Education Week, May 2, School Computer Deal Includes Families by Andrew Trotter. Retrieved May 10: www.edweek.org/ew/ewstory.cfm?slug=33deal.h20

Education Week, May 23, Testing Computerized Exams by Andrew Trotter. Retrieved June 11: www.edweek.com/ew/ewstory.cfm?slug=37online.h20

Goldwater Institute. February 14, Arizona's Charter Schools: What Do We Know? by Tom Patterson. Retrieved March 21: www.goldwaterinstitute.org/perspectives/0104.htm

Indianapolis Star, March 27, High School to Divide into 'Career Academies' by Sally Falk Nancrede. Retrieved March 27: www.starnews.com/news/articles/pike0327.html

New York Times, April 4, Group Aims to Fine Tune Wired Schools by Rebecca S. Weiner. Retrieved April 4: www.nytimes.com/2001/04/04/technology/04EDUCATION.html

New York Times, April 20, Schools Are Now Marketers Where Choice Is Taking Hold by Jodi Wilgoren. Retrieved April 20: www.nytimes.com/2001/04/20/national/20CHOI.html

New York Times, April 25, Online Courses to Improve Teacher Technology Skills by Rebecca S. Weiner. Retrieved April 25: www.nytimes.com/2001/04/25/technology/25EDUCATION.html

New York Times, May 8, Education: School District Buys 23,000 Laptops by Rebecca S. Weiner. Retrieved, May 9: www.nytimes.com/2001/05/08/technology/09EDUCATION.html

Philadelphia Inquirer, February 23, Pa. Chooses Its First Digital School Districts by Ovetta Wiggins. Retrieved, February 23: inq.philly.com/content/inquirer/2001/02/23/city/SDIGITAL23.htm

Philadelphia Inquirer, March 26, Phila., Chester Upland Look Abroad for Teachers by Susan Snyder. Retrieved March 27: inq.philly.com/content/inquirer/2001/03/26/front_page/PINDIA26.htm

The Plain Dealer, March 22, Cleveland ready to hire 50 teachers from India by Janet Okoben. Retrieved March 23: www.cleveland.com/news/index.ssf?/news/pd/c22teach.html

PR Newswire, April 6, Casio, Inc., Announces an Educational Technology Curriculum Training for Teachers Nationwide. Retrieved April 6: www.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STORY=/www/sto.../0001463186&EDATE

St. Petersburg Times, May 7, Course credits only a point, click away by Monique Fields. Retrieved May 8: www.sptimes.com/News/050701/NorthPinellas/Course_credits_only_a.shtml

San Francisco Chronicle, April 1, Reformers Push Small Schools, by Elizabeth Bell. Retrieved April 1: www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2001/04/01/MN120526.DTL

Seattle Times, April 3, High-speed Internet network to link 200 research centers, universities by Tan Vinh. Retrieved April 3: archives.seattletimes.nwsource.com/cgi-bin/texis/web/vortex/display?slug=internet03m&date=20010403

Seattle Times, June 15, Confab points up rise in home-schools, by Brad Wong. Retrieved June 15: www.seattletimes.nwsource.com/html/localnews/134306893_homeschool15m.html

Star Tribune, March 20, Editorial: City High Schools: Making Programs More Student-Friendly, Retrieved March 20: www.startribune.com/stOnLine/cgi-bin/article?thisSlug=ED20A&date=20-Mar-2001

University of Maryland University College, Press Release, February 28. Retrieved June 26: www.umc.edu/events/press/news30.html

USA Today, April 4, MIT Makes Course Materials Free Over the Net. Retrieved June 19: www.usatoday.com/news/nation/2001-04-04-mit.htm

Washington Post, May 10, Calvert Home-Schoolers Join Fray on Movement's 2nd Front, by Nancy Trejos. Retrieved May 10: www.washingtonpost.com/wp-dyn/education/A6521-2001May9.html

The Futurist Files

Looking for leadership into the future of education? Keep your eye on these eight education futurists.

by Melanie Shreffler, ENC Publishing

Have you wondered what education and the teaching profession will look like in 75 years? 25 years? Or even five years? Everyday, someone is developing new technologies, new legislation, and new learning theories that could begin to transform our schools tomorrow. Education futurists think about how new developments—and possible future developments—will one day impact the nation's schools.

But futurists don't simply peek into their crystal balls to see what the future of education will look like. Instead, they study the trends of the time, apply what they know about the history of education, and then speculate about how the future of education will be affected. Some of their predictions seem like fantasies that will never be realized, but ten years ago did you think you would be sending electronic mail and accessing books on the Internet right in your classroom? Educational futurists did.

Here is a sampling of futurists to listen to as they tell us today what the future might look like tomorrow.

Alan Bersin

Superintendent, San Diego Public Schools

Anthony Alvarado

Chancellor of Instruction, San Diego Public Schools

Specialization: Nontraditional Administration and School Reform

Web site: www.sandi.net

Bersin and Alvarado are creating a stir with their unique partnership to reform the San Diego Public Schools. Bersin, a businessman with no background in the field of education, runs the business side of the school system while Alvarado, a former superintendent with plenty of experience in public education, runs the education side.

Notable Quote:

Issues of student achievement cannot be separated from issues of teacher expertise, professional development, prevention and intervention strategies, curricular alignment, assessment strategies, school leadership, and funding. To be successful, efforts...must include changes in all of these areas.

It is one thing to embrace the idea that all children can learn; it is another thing to make sure they do learn. That is the premise of the Blueprint for Student Success,

... organizing the school district to accomplish the goal of achievement for all students.

—from *Blueprint for Student Success*

Recent Publications:

San Diego City Schools. (2000). *Blueprint for Student Success.* www.sandi.net/comm/current_issues/blueprint/blueprint.html

Cuban, Larry & Usdan, Mike. (2001, April 22). A Noneducator Pulls Off the Impossible: Urban School Reform. *Los Angeles Times*, p. M6.

Gewertz, Catherine. (2000). 'Blueprint' for San Diego Schools Draws Mixed Reactions. *Education Week*, (19)6 5.

Linda Darling-Hammond

Executive Director, National Commission on Teaching and America's Future

Specialization: Teacher Education, Professional Development

Web site: www.nctaf.org

Darling-Hammond considers the teacher of tomorrow. She studies how teachers will be educated and how the country will deal with the growing shortage of teachers.

Notable Quote:

My research and personal experience tell me that the single most important determinant of success for a student is the knowledge and skills of that child's teacher.... In my policy research, I've seen how hundreds of curriculum reforms have failed because, where the rubber meets the road, no curriculum reform succeeds if teachers do not have the knowledge of the content and strategies to teach it well.

It is the balance between deep knowledge of content and deep knowledge of children that leads to success.

—from *Phi Delta Kappan*, An Interview with Linda Darling-Hammond: Balanced Optimism

Recent Publications:

Goldberg, Mark. (2001). An Interview with Linda Darling-Hammond: Balanced Optimism. *Phi Delta Kappan*, (82)9, 687-690.

Solving the Dilemmas of Teacher Supply, Demand, and Standards: How We Can Ensure a Competent, Caring, and Qualified Teacher for Every Child. (2000). www.nctaf.org/publications/solving.pdf

With Arthur Wise & Stephen Klein. (1999). *A License to Teach: Building a Profession for 21st Century Schools.* San Francisco: Jossey-Bass.

Teacher Learning That Supports Student Learning. (1999). glef.org/EdutopiaPDF/62S99.pdf

The Right to Learn: A Blueprint for Creating Schools That Work. (1997). San Francisco: Jossey-Bass.

Michael Fullan

Dean, Ontario Institute for Studies in Education

Specialization: School Reform, Change Efforts

Web site: home.oise.utoronto.ca/~mfullan

Fullan challenges current ideas for school reform and offers his theories about how change can ultimately come about.

Notable Quote:

Rationally constructed reform strategies do not work. The reason is that such strategies can never work in the face of rapidly changing environments. Further, rapid change is endemic and inevitable in a postmodern society—a system which self-generates complex dynamics over and over again.... The old way of managing change, appropriate in more stable times, does not work anymore.

—from *Change Forces: The Sequel*

Recent Publications:

The New Meaning of Educational Change. (2001). New York: Teachers College Press.

The Three Stories of Education Reform. (2000). *Phi Delta Kappan* (81)8 581-584.

Change Forces: The Sequel. (1999). Philadelphia, PA: Falmer Press.

With Andy Hargreaves. (1996-1998). *What's Worth Fighting For* (series). New York: Teachers College Press.

Change Forces: Probing the Depths of Educational Reform. (1993). New York: Falmer Press.

Alan November

Senior Partner, Education Renaissance Planners

Specialization: Technology in Education, Professional Development

Web site: www.anovember.com

November studies how technology enables students to direct their own learning, and how that ability will determine the way students of tomorrow will learn.

Notable Quote:

I have learned about two ways to think about technology: one is called automating, the other is called informating. One will give you incremental improvement; the other will give you big improvement. Unfortunately schools and technology planning tend to focus on automating. This means that you bolt technology on top of what you're already doing. ... You get very different results when you informate. The real revolution is information and communication, not technology. Let go of the word technology. *If you focus on it, then you'll just do what you're already doing. The trick in planning as we move forward is to think about information systems, whole systems of the flow of information and communication.*

—from *Creating a New Culture of Teaching and Learning*

Recent Publications:

Empowering Students with Technology. (In press). Arlington Heights, IL: SkyLight Professional Development.

Creating a New Culture of Teaching and Learning. (1998). www.anovember.com/articles/asilomar.html

With Barbara Kurshan & Jane Stone. (1986). *Computer Literacy Through Applications.* Boston: Houghton Mifflin.

Mitchel Resnick

Director, The Lifelong Kindergarten, MIT Media Lab.

Specialization: Technology in Education, Decentralized Learning

Web site: llk.media.mit.edu

Resnick explores how technology can reinvent teaching and learning for a digital society by encouraging pedagogies that stimulate creativity and invention. He has studied how technology can assist in creating decentralized learning.

Notable Quote:

Increasingly, science educators are recognizing the value of learners designing their own scientific investigations (rather than replicating well-known experiments). Through our case studies, we have tried to demonstrate that designing your own tools can be a particularly important component to designing your own investigation.

Our ultimate goal is to contribute to the development of a new generation of students who are more likely to "look inside" the technological artifacts in the world around them—and feel empowered to develop their own tools (even very simple tools) for exploring phenomena in their everyday lives.

—from Beyond Black Boxes: Bringing Transparency and Aesthetics Back to Scientific Investigation

Recent Publications:

With Robbie Berg, Bakhtiar Mikhak & Diane Willow. (2000). Learning with Digital Manipulatives: New Frameworks to Help Elementary School Students Explore "Advanced" Mathematical and Scientific Concepts. llk.media.mit.edu/papers/2000/digital-manip.html

With Robbie Berg & Michael Eisenberg. (2000). Beyond Black Boxes: Bringing Transparency and Aesthetics Back to Scientific Investigation. *Journal of the Learning Sciences*, (9)1 7-30. llk.media.mit.edu/papers/2000/bbb

Turtles, Termites and Traffic Jams: Explorations in Massively Parallel Microworlds. (1997). Cambridge, MA: MIT Press.

Phillip Schlechty

President and CEO, Center for Leadership in School Reform

Specialization: School Reform, Educational Leadership

Web site: www.clsr.org

Schlechty is a student of change (or lack thereof) in the educational system. He is especially knowledgeable about recent trends toward the privatization of schools.

Notable Quote:

Change is usually motivated by one of two conditions: (1) a threat so grave that change is mandatory for survival or (2) a vision so compelling and attractive that the preservation of the status quo and the security of present arrangements pale in significance. Lasting change cannot, however, be sustained by threats, though the presence of threats is sometimes essential to get change started. Threats without vision create fear, defensiveness, and a siege mentality. Real threats, coupled with a positive vision of the future, can create commitment and passion, two ingredients that must be present if change is to be sustained.

—from *Inventing Better Schools: An Action Plan for Educational Reform*

Recent Publications:

Inventing Better Schools: An Action Plan for Educational Reform. (1997). San Francisco: Jossey-Bass.

Schools for the 21st Century: Leadership Imperatives for Educational Reform. (1990). San Francisco: Jossey-Bass.

Sparks, Dennis. (1998). An Educator, Examined: An Interview with Phillip Schlechty. *Journal of Staff Development* (19)3, 38-42.

David Thornburg

Director, The Thornburg Center

Specialization: Technology in Education, Project-Based Learning

Web site: www.tcpd.org

Thornburg has a talent for seeing the future of technology, especially how it can revolutionize the way teachers teach and students learn.

Notable Quote:

As with the first Renaissance, Renaissance 2000 is triggered by a new mode of communication—one as powerful as print, and one with the powers that print never had: the Internet (and, in particular, the World Wide Web).

The mark of an educated person during the Renaissance was his or her capacity to think intelligently about a wide range of topics. Beyond that, Renaissance thinkers were creative people, not just those who memorized a large number of disconnected facts. They also thought in terms of projects, not in terms of isolated facts. The holistic approach to learning takes on new power during Renaissance 2000, and forms a foundation for a complete overhaul of educational practice in our schools today.

—from Renaissance 2000

Recent Publications:

Campfires in Cyberspace. (1999). San Carlos, CA: Starsong Publications

Brainstorms and Lightning Bolts: Thinking Skills for the 21st Century. (1998). San Carlos, CA: Starsong Publications

Renaissance 2000 (white paper commissioned by the Congressional Institute for the Future). (2000). www.tcpd.org/thornburg/handouts/R2K.pdf

Consider This with David Thornburg (monthly commentary for PBS 1998-present). www.pbs.org/teachersource/thornburg/thornburgarchive.shtm

Melanie Shreffler edits print and online publications for ENC. She has a background working with teacher education organizations. Email: mshreffler@enc.org

Breaking New Ground in Alaska

New horizons in teaching are not always about new techniques, curriculum, or technology. A new horizon can also be a melding of new and old cultures to foster improved student learning.

by Leslie Sears Gordon, University of Alaska, Fairbanks

The sky was deep blue and the sun had been up for hours as three boats set off from the landing on the Tanana River near Fairbanks, Alaska. The boats were filled with 19 teachers from all over the state. They had come to Fairbanks to attend a 10-day summer institute that is part of the Global Change Education Using Native Knowledge and Western Science program. Each teacher paid $100 tuition to attend the four-credit graduate course offered by the University of Alaska.

The goal for this three-year project, funded by the National Science Foundation, is to support teachers in Alaska, especially those in rural areas, by melding science from the Western tradition, Alaska Native knowledge, and best practices in math and science education. Our belief is that the native knowledge and best practices (especially constructivism and inquiry) components of the project will improve the learning of Western science and math in rural schools where students have traditionally had difficulty with these subjects.

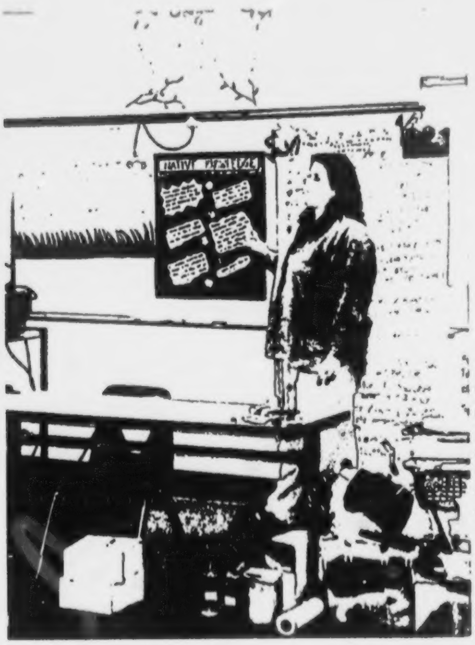
Photo by Elena Sparrow

The Global Learning and Observations to Benefit the Environment (GLOBE) Program provided the Western science of the summer institute. In this program, teachers and students can participate in real scientific studies by collecting data that are then used by scientists who are studying environmental issues. (See box.)

During the summer institute, teachers are trained in the basic GLOBE protocols, a set of directions for taking measurements and other techniques. They receive instrument kits that provide the equipment their students will need to participate in long-term research on global change.

The institute was structured around the five GLOBE strands: Atmosphere, Hydrology, Soils, Land Cover/Biology, and Earth Systems. For example, the trip on the Tanana River introduced Hydrology. On the river, at a fish camp, and from the stories of the boat pilots, teachers learned how the Athabascans, the Native Alaskans in this region, viewed the river and how the river has changed over time. Teachers could see for themselves that the pilots respected and understood the river because this knowledge meant their survival.

Teachers also read and discussed *Handbook for Culturally Responsive Science Curriculum* by Sidney Stephens, one of the principal investigators on the project. The book addresses how to create curricula that are standards-based and integrates native knowledge and Western science. It also discusses best practices and assessment.



Photos on this page by Leslie Sears Gordon

Best practices were modeled and discussed throughout the institute. Teachers wrote in their journals and shared their writings with the staff. The agenda was adjusted on a daily basis to accommodate the teachers' needs.

The teachers had the opportunity to work in small groups and pursue their own inquiries in the field. They also had the opportunity to demonstrate what they had learned at the institute during a final presentation in any "intelligence" they selected (Gardner, 1983). Presentations ranged from native dance, song, and puppet shows to lesson plans for teachers to use in their classrooms.

Evaluation of the institute was accomplished through the collection of both qualitative and quantitative data, including pre- and post-attitude assessment (which will be repeated yearly for all teachers).

When teachers return to their classrooms, they continue to receive support from the program staff and scientists through email, phone, fax, and occasionally on-site visits. The environmental data that their students have collected are available on the GLOBE web site.

Leslie Sears Gordon is co-principal investigator on the Global Change Education Using Native Knowledge and Western Science program with Sidney Stephens and Elena Sparrow. The project is housed in the School of Agriculture and Land Resource Management of the University of Alaska. Now retired, Gordon was a teacher and staff developer for Fairbanks Northstar Borough School District. She received the Presidential Award for Excellence in Science Teaching and the Milken National Educator Award.

References

Gardner, Howard. (1983). *Frames of Mind.* New York: Basic Books.

Stephens, Sidney. (2000). *Handbook for Culturally Responsive Science Curriculum.* Fairbanks: Alaska Science Consortium and Alaska Rural Systemic Initiative.

GLOBE: Global Learning and Observations to Benefit the Environment

GLOBE is a nonpartisan effort of the U.S. government to gather environmental data globally. Based in primary and secondary schools, the program reaches nearly every corner of the world and engages young people in a common scientific endeavor. Teachers in more than 8,000 schools in 96 countries are involved with GLOBE. Participants range from elementary youngsters to college students. GLOBE participants form a powerful Internet community, as students and scientists work together to gather environmental data that can help everyone better understand our world environment.

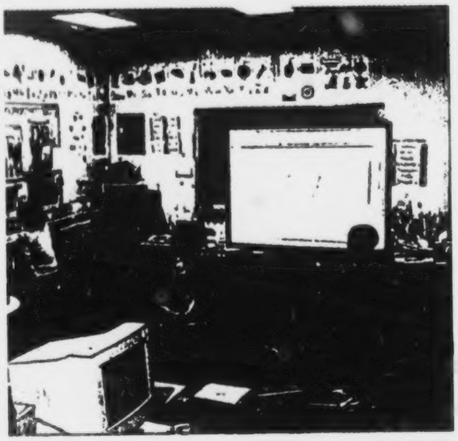
For more information, visit GLOBE's web site at www.globe.gov, or call 1-800-858-9947.

Learning in Motion

This first-grade teacher believes in trying the newest tools and techniques to engage her students and help them learn.

by Kathleen D. Hogan, Hyattsville Elementary School, Hyattsville, Maryland

In the past few years, I have been interested in "teacher research," a practice that encourages teachers to collect and analyze data in their classrooms. The sources of data—student work, audio- and videotapes of class activities, student interviews, surveys, and anecdotal notes—enable me to delve into each child's reactions and responses as I develop or implement activities.



Photos by Kathleen Hogan

When I first began doing teacher research, I met a first-grade teacher who was documenting how she used motion detectors with her students. Since motion detectors typically are used in high school and college physics classes, her research fascinated me. I decided to use a similar activity to promote inquiry and interpretation of graphs in my first-grade classroom.

I used a motion detector and software designed for educational purposes and available from school suppliers such as Pascal and Vernier. The detector uses infrared signals and is attached to a computer with specially designed software that displays an object's or person's movement in the form of a graph. The graph represents how far the person is from the motion detector (distance) at each instant during the motion (time).

In my classroom, I was able to connect the computer with a projector so that the children could see the graphs on a classroom-size screen. When students moved in front of the motion detector, they could watch lines appear on a graph. As the children moved toward the motion detector and decreased their distance from the device, the lines on the graph would go down. As they moved away from the motion detector and increased the distance, the lines on the graph would go up. When a child stood still, a horizontal line appeared on the graph.

Starting the Activity

It is important to set up the computer and motion detector in an area with plenty of room so that the children can move freely. My goals for the initial activity were to explore motion and discuss the resulting graphs. I did not want the discussion to get lost in the fun—I wanted it to be a part of the fun.

We began by having a conversation about motion detectors. (All of the dialogue that follows is taken from my research data.)

One student said, "There is one at the grocery store. It is a black box up high that makes the door open when I come near it." He explained it could see him because it was "Magic!"

I replied, "Okay. Technology is like magic…amazing things can happen when using technology."

Another student pointed out, "Someone made it do that."

I acknowledged this response by comparing the motion detector to video games: "There is something inside the game that senses that you are pushing the buttons. When you push the buttons, it makes something happen in the game."

Next, it was time to "play" in front of the motion detector. I modeled for the students as I explained that they should move directly in front of the motion detector since that was where the sensor was located. They could move any way they chose, by themselves or with a partner. Some children moved backwards and forwards. Others stood still, shaking their arms and legs and jumping up and down. Others danced and did karate kicks.

As each student or pair of students experimented, the class talked about the changing graphs and made connections to other things they had seen.

They said, "It looks like mountains." "…like tall mountains and then short mountains." "…like the letter M." "...like the letter W." "No, they look like icicles." "They look like both (mountains and icicles)." "…like buildings." "…like a cow's udder." "…like those things in caves that hang down." One girl compared the look of the sloping lines to stock market graphs.

Adding Depth to the Learning

I hoped the children would notice the relationship between their directional movement and the line created on the graph. When the last student took his turn, someone noticed a similarity between his line and another

Standards Met in This Activity

The following National Science Education Teaching Standards were met through this activity. These standards help educators question their practice and act upon their thoughts about teaching, thus complementing the National Science Education Content Standards for Science as Inquiry.

- Standard A: Teachers of science plan inquiry-based science activities.
  The students explored their own ways of moving in front of the motion detector. They observed, asked questions, made predictions, and tested their thinking. They recorded their thoughts.
- Standard B: Teachers of science guide and facilitate learning science.
  I was there to guide the students as they explored ways of moving in front of the motion detector and discovered what happened. I facilitated their discussions and maintained a positive learning environment.
- Standard C: Teachers of science engage in ongoing assessment of their teaching and of student learning.
  I used a videocassette recorder to assess my teaching and student learning. This enabled me to focus on the students' reactions, responses, and understandings so I could plan what to do next.
- Standard D: Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.
  The students were given the necessary time and space to freely explore their movement in front of the motion detector and discuss their findings. I connected the computer to a projector so that all of the students could see the graphs at the same time.
- Standard E: Teachers of science develop a community of science learners that reflects the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.
  The students are becoming better problem solvers. They were eager to discover answers for themselves. They have applied what they've learned in this activity to other situations as they continue making observations, asking questions, and solving problems.
- Standard F: Teachers of science actively participate in the ongoing planning and development of the school science program.
  I have shared these activities with my colleagues and will be helping them develop and implement activities to use with their students. I evaluated the software and hardware necessary to do this activity and presented it to my school district's technology office. My principal purchased the necessary equipment as well as temperature probes that will help students gain understanding about graphs in another way.

student's line. We tried to replicate the line. One girl came close. She didn't explain herself in words, but her movement demonstrated that she realized she had to move in a certain way to replicate the line.

To extend this thinking, I gave the children some specific movements to use in front of the motion detector. First, I stood still and then moved slowly backwards, away from the motion detector. The students compared my line to the "mountains" earlier. Then, I asked a student to stand far away and walk slowly forward, toward the motion detector, and stop. This was the opposite of what I had done, and students compared the graphs.

Then, I had the children predict what a line would look like, given specific directional commands. I acknowledged all responses, praising the students for their attempts. One girl, who was adamant that her prediction was right, said, "The line is going to go up when I go backwards." Her classmates cheered as she correctly modeled what she had predicted. More students were gaining understanding through this interaction.

Next, I called out directions quickly for one student and then very slowly for another student. It was apparent that some were catching on to the fact that their speed also had an effect on the line. (The faster the person moved, the steeper the slope of the line.) Some observations were, "She made lots of letter Ms and he made only one." "That's because she went faster." These statements showed that the students were testing their thinking.

Writing About the Experience

The students wrote about this experience and created drawings that illustrated their writing. One student wrote, "I remembered when I made ice going down. I walked like I was dancing. I was standing still and dancing." Another student wrote, "I played with the motion detector. It made scribble scrabble. I stood still and made wobbled lines." Another wrote, "When I played with the motion detector it was fun. I went back and forth, and it made mountains. My friend did karate on the motion detector."

To help the children write about their observations, I gave the students some sentence starters: When the person stood still...When the person walked forward... When the person walked away (or backward)...

Most students wrote immediately. A few needed partners. One student only wrote a few words to describe his movement. He wanted to contribute, but writing was extremely difficult for him. His few words, "I stood still... straight," were just as powerful as another student's many words, "When I went in front of the motion detector, it made a straight line when I stood still. When I went backwards, it made a line that went up. When I went forwards the line went down." Both students were gaining understanding.

I have presented this activity at several conferences. Many teachers are amazed that first graders are using this technology. However, at one conference, a teacher said, "We don't need motion detectors to teach graphing." I thought to myself, "We don't—but my students needed it." Several of the children needed another way to help them understand graphs as well as the motivation to try. The motion detector provided both.

Because of the success with this activity, I teamed with a co-worker to develop a session that integrated science and language arts. We used the motion detector to teach writing of sequential directions, a first-grade language arts learning outcome (Hogan & Barton, 2000).

Kathleen Hogan has a degree in early childhood education. Currently she teaches at Hyattsville, Maryland, Elementary School. The research project described in this article was funded through a grant from the U.S. Department of Education. Under the supervision of Emily van Zee, a science education faculty member at the University of Maryland at College Park, Hogan and other classroom teachers met biweekly, after school, developing research questions to explore in the context of their teaching practice. They were encouraged to present their case studies at conferences.

References

Hogan, Kathleen & Barton, Pamela. (2000). Imagine Using a Motion Detector to Get Students to Write Clear Sequential Directions! Paper presented at the Fairfax County Teacher Researcher Conference, Tyson's Corner, VA and the Prince George's County Teachers-As-Researchers Conference, College Park, MD.

Mokros, J.R. & Tinker, R.F. (1987). The Impact of Microcomputer-Based Labs on Children's Ability to Interpret Graphs. *Journal of Research on Science Teaching* 24, 369-383.

National Board for Professional Teaching Standards. (2000). Retrieved April 9, 2001: www.nbpts.org

National Research Council. (1996). *National Science Education Standards.* Washington DC: National Academy Press.

Roberts, Deborah. (1998). Physics and First Graders—What a Good Match! Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Science Hardware and Software for the Classroom. Retrieved April 9, 2001: www.vernier.com

New Horizons

Part of the Eisenhower Network (see pages 8 & 9), the ten Eisenhower Regional Consortia are at the forefront of the effort to improve mathematics and science education in schools in every state and territory in the nation. Who better to update ENC Focus *readers on the latest educational trends?*

Let's follow the path of the sun to find out what's happening across the country.

In the Northeast: Collaborative Inquiry Uses Data to Get Results

by Ken Mayer, Eisenhower Regional Alliance for Mathematics and Science Education at TERC

Tuesdays in the Concord, New Hampshire, Public School District are alive with academic inquiry. Groups work together, ask questions, examine assumptions, and tear apart data. This scene, however, is not taking place among students, but among teachers participating in "Data Tuesday Training Days." Using an Eisenhower grant to fund release time for professional development, Concord is making sure that every mathematics teacher in the district knows how to use a collaborative inquiry process to improve the district's mathematics program.

The process modeled at the Concord sessions is detailed in *Using Data—Getting Results* by Nancy Love. The book grew from Love's work as a professional development specialist for the Eisenhower Regional Alliance for Mathematics and Science Education at TERC. Collaborating with a network of schools throughout the Northeast, Puerto Rico, and the Virgin Islands, the Alliance piloted many of the techniques now outlined in the book. Love saw that teachers struggling to improve their practice could benefit from the same methods used by professional developers.

In the book, Love presents a rationale, guidance, and reams of practical data collection and analysis tools for school districts that want to use data to improve student learning. She challenges conventional assumptions about what data are and how to use them in the context of educational reform. She explains, "...many of the trends in education reform have been based on intuition and speculation, rather than on rigorous use of data. There is an over-reliance on high-stakes standardized tests that

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Improving Mathematics and Science Education

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leads to lots of activity with no way to measure whether the changes are working."

Love contends that when educators and policymakers only use results from standardized tests to spur on reforms, the data can become a club to punish poor-performing schools rather than a means to diagnose problems, spark action, and improve learning. Love stresses that in addition to standardized tests, schools can use other measures such as performance assessments, student work, enrollment figures, classroom observations, and interviews.

Using Data—Getting Results calls not only for looking at a problem through many lenses, but also for disaggregating data, which requires breaking down data to highlight results for individual subsets such as grade level, gender, ethnic, or economic group. Love's book contains templates and case studies to illustrate how to disaggregate data and how the process can uncover problems and challenge assumptions.

In one example, she describes how the public schools in Providence, Rhode Island, looked at course enrollment data to address poor performance in mathematics. The data revealed that students of color were underrepresented in high-level mathematics courses. The district also looked at research showing that students who do not take algebra or geometry in high school are 40 to 60 percent less likely to complete college. In response, the district untracked mathematics instruction, offering algebra to all students. After six years, failure rates have dropped, and more students are taking third- and fourth-year mathematics courses. Love contends that "data are the compelling evidence that grounds conclusions in actual results, not in speculation" (Love, 2001, p. 7.16).

Chris Demers, the Concord-based educator who is implementing the Tuesday data training sessions, notes that *Using Data—Getting Results* has been a natural fit as his district strives to meet state requirements. While he expected resistance from teachers who have been asked to jump on and off so many educational "next-big-thing" bandwagons, he reports that teachers welcome the collaborative framework of Love's process. "It values them as intrinsic to the solution and helps them reflect on their personal practices while looking at statewide numbers. The process also models the process we want teachers to use with their students, which helps them be better teachers when they leave the session."

An inquiry-based approach takes extra time to frame solutions, but the resulting solutions hit the mark with greater accuracy. The solutions can also be revised to keep hitting the mark as the educational target moves. Love says, "In inquiry-based schools, teachers and administrators continually ask questions about how to improve student learning, experiment with new ideas, and rigorously use data to uncover problems and monitor results.... Researchers in both business and education agree that these qualities are hallmarks of the most successful organizations" (Love, 2001, p.1.11).

Reference

Love, N. (2001). *Using Data—Getting Results: A Practical Guide for School Improvement in Mathematics and Science.* Norwood, MA: Christopher-Gordon.

America's Lesson Study Laboratory Emerges in the Mid-Atlantic

by Jim Harper, Mid-Atlantic Eisenhower Regional Consortium for Mathematics and Science Education at Research for Better Schools

Take a low-performing, K-8 urban school serving impoverished and multilingual students, add a forward-thinking principal and Japanese-style professional development, and what do you get?

At Paterson School #2 in northern New Jersey, the result is success. In the past decade, eighth-grade test scores have surged from well below the district average to well above. The school's teachers have become national advocates and models of Lesson Study, a common form of collaboration in Japan. Principal Lynn Liptak, who joined School #2 after a state takeover of the Paterson district in 1992, was named one of "Ten People Who Shaped the Decade" by *Teacher Magazine* in 1999.

School #2 is also one of five schools working with the Mid-Atlantic Eisenhower Consortium @ RBS in its Middle School Mathematics Project—launched last year in coordination with the Eisenhower Network. For the past two years, the Consortium has supported School #2's Lesson Study efforts. Recently, Liptak and I had an "email conversation" regarding this dynamic model of professional development.

Q: Describe the Lesson Study process.

A: Lesson Study is a form of professional development called "practical inquiry." An actual classroom lesson is the focus for the study. The steps are:

1. Select a topic or theme based on observation of students' needs.
2. Plan a lesson collaboratively.
3. Implement the lesson with other teachers observing.
4. Critique the lesson.
5. Rewrite the lesson based on the critique.
6. Reteach the lesson with many teacher observers as well as outside observers.
7. Discuss/critique the lesson again.
8. Share the results.

The process is driven by teachers and focuses on students.

Q: How were you introduced to Lesson Study?

A: In 1997, we became interested in Japanese teaching after viewing the TIMSS Videotape Study. In the videotapes, we saw the power of the Japanese lessons. We devised similar lessons and our students responded favorably. We learned more about Lesson Study by reading the article "A Lesson Is Like a Swiftly Flowing River" (Lewis & Tsuchida, 1998).

Q: What convinced you to try this approach?

A: After seeing the TIMSS videotapes, we formed a voluntary Mathematics Study Group —composed of 10 teachers from School #2 and myself—to explore ways to improve the teaching and learning of mathematics. We visited constructivist classrooms, videotaped our lessons, read books and articles, and linked with knowledgeable advisers such as Patsy Wang-Iverson of Research for Better Schools. We observed each other's classes and became very interested in improving our practice. We found that at grade-level meetings we spent too much time on issues that were not directly focused on classroom instruction, so the Math Study Group became something special, where teaching and learning were truly central.

Q: What successes and challenges have you experienced?

A: When I see students actively struggling with difficult mathematics problems, debating mathematical proofs with each other, or experiencing the moment when the "lights go on," those are high points. When teachers and I are actively struggling with difficult mathematics problems or debating pedagogy with each other, those are high points.

At times cultural barriers seem insurmountable—will we ever learn to be deeply critical? Can this ever become part of our school culture? If I look too far ahead and allow myself to be overwhelmed by the odds, those are low points.

Q: What is your current level of commitment to Lesson Study?

A: The greatest cost of Lesson Study is our time. The Math Group has a weekly, two-hour meeting during school time. The classes the teachers miss are covered by other staff or visiting preservice teachers. This meeting is truly seed time. Once teachers get excited about collaborating and about the process, they find ways to meet before and after school, during lunch, during preparation time. They do extra work after school and on weekends. This is all voluntary, as is participation during the school day.

The Mid-Atlantic Eisenhower Consortium has provided funding and Dr. Wang-Iverson's assistance. Also we have become an intensive site under the Consortium's Middle School Mathematics Project. It is extremely useful and enriching to have committed people working with us side-by-side over the long haul.

Q: How would you address concerns that Lesson Study is too time-consuming?

A: Professional development that is going to make a difference to students must be teacher-driven and student-focused. Lesson Study is both of these things. For too long, teachers have been the recipients of the wisdom of non-teachers. Teachers need to create their own wisdom, aided by knowledgeable non-teachers who are invested in their success and willing to work with them.

In my opinion and experience, the time invested in Lesson Study yields dividends. It is the most powerful way I have seen for teachers to reform practice.

Q: How would you address the concern that Lesson Study is a Japanese technique that isn't appropriate for American culture?

A: If we are going to have the schools we purport to want, we must change the culture of American schools. We also need to learn to be "critical friends." As Americans, we tend to take criticism personally. I think we have to adapt American culture to Lesson Study and Lesson Study to American culture if it is to be effective in our schools. It will not be exactly as it is done in Japan. We will have to re-create it for ourselves.

A more extensive version of this interview is available in RBS Currents Volume 4.1, available online (www.rbs.org/ec.nsf/Currents).

References

Lesson Study: Readings & Resources on the Lesson Study Approach to Professional Development. (2001). Research for Better Schools. Retrieved on June 7, 2001: www.rbs.org/ed.nsf/pages/LessonStudy

Lewis, C. & Tsuchida, I. (1998). A Lesson Is Like a Swiftly Flowing River. *American Educator*, 12-17/50-52. Retrieved on April 9, 2001: lessonresearch.net

Video Examples from the TIMSS Videotape Classroom Study: Eighth Grade Mathematics in Germany, Japan, and the United States. (1998). National Center for Education Statistics, U.S. Department of Education. Retrieved on April 9, 2001: (nces.ed.gov/pubsearch/pubsinfo.asp?pubid=98092).

From Appalachia: A New Guide for Using Graphing Calculators

by Iris Hubbard, Center of Excellence for Science and Mathematics Education at the University of Tennessee, Martin, and Charlotte Blane, Appalachia Eisenhower Regional Consortium for Mathematics and Science Education at AEL

In cutting-edge mathematics classrooms, the graphing calculator is used to develop a richer understanding of concepts rather than just to obtain answers to problems. Middle school teachers hoping to reach that goal can turn to a new resource: *Graphing Calculators in Middle Grades Mathematics: A Resource Guide for the Classroom and for Professional Development.*

The *Guide* was developed by the Appalachia Eisenhower Regional Consortium for Mathematics and Science Education at AEL, in collaboration with the Center of Excellence for Science and Mathematics Education (CESME) at the University of Tennessee at Martin. It consists of 17 calculator-enhanced lessons that focus on the development of key middle-grades mathematics concepts.

Reproducible student handouts provide detailed instructions. Each lesson also includes teachers' notes, which were written and reviewed by classroom teachers. The notes consist of an outline, answers to the student activities, discussion points, suggestions for written or performance-based assessment, and ideas for extending the lessons. Calculator instructions include keystrokes and related calculator screens for the TI-73, TI-83 Plus, Casio FX-7400G Plus, and the Casio CFX-9850GB Plus.

The lessons are aligned with national standards for mathematics and connect mathematics to the real world and to other disciplines in ways that will actively engage middle-grade students. One lesson relates mathematics and science, and another uses a sports context to help develop and reinforce statistical concepts. A number of the lessons make connections between mathematical topics such as geometry and algebra. For the most part, lessons contain both paper-and-pencil and calculator activities that encourage students to explore concepts in problem-solving contexts.

Extensions and adaptations of the lessons suggest ways to modify them for different age groups and in some cases suggest alternative materials or projects. Teachers may want to use some of the activities as a demonstration or for a whole class discussion as appropriate

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for that particular grade level and based on the availability of graphing calculators.

As indicated in the title, the *Guide* can also be used for professional development. In this situation, the purpose of the lessons is two-fold: to model appropriate integration of the graphing calculator into instruction and to familiarize participants with calculator keystrokes. The user-friendly format of the *Guide* makes it adaptable for individual or group professional development activities. The activities can also be used for assessment of the effect of graphing calculators on student learning.

The lessons used in *Graphing Calculators in Middle School Mathematics* were developed by five Tennessee classroom teachers and a CESME mathematics coordinator. In addition, a team of Virginia teachers reviewed a draft of the *Guide*, and their suggestions were incorporated in the final edition. Five of the 17 lessons were extensively revised for middle grades from an earlier publication, *Graphing Calculators in Mathematics, Grades 7-12* (CESME/AEL, 1998).

To find out more or to order copies of the Guide, *visit the web site (www.ael.org/calculator2).*

In the Southeast: Students Do! Students Write! Students Learn!

by Malcolm B. Butler, Southeast Eisenhower Regional Consortium for Mathematics and Science Education @ SERVE

"Students enjoy working with science kits, but are they learning?" This question could easily be asked of elementary teachers using the many kit-based science programs now available. The Southeast Eisenhower Regional Consortium for Mathematics and Science Education @ SERVE is helping to answer the question. Working with the Hands-on Activity Science Program (HASP), the Consortium is seeking evidence to support use of kits. Research has shown some benefits (Saul & Reardon, 1996), but effects on student learning have not been well documented.

For the past ten years, HASP, in collaboration with the Institute for Science Education of the University of Alabama in Huntsville and eight school districts, has been part of a National Science Foundation grant supporting science education reform. HASP serves more than 30,000 students and their teachers in northern Alabama, which includes rural, urban, and suburban schools.

Several indicators show that HASP has reached the goal of increasing student understanding of science concepts through inquiry-based activities. Now HASP is taking its program to another level by adding a science notebook component. The proposal is based on the belief that writing about their science experiences will enhance students' abilities to record and analyze data, reflect on the information, and communicate with their peers about what they have learned.

Roslyn F. Pressnell, director of HASP, points out that science notebooks can be a means to integrate the curriculum. "Teachers are struggling to fit everything into a school day," she comments. "When you are teaching science through inquiry, that is the obvious time to teach children to write."

The Southeast Eisenhower Regional Consortium is supporting HASP with technical assistance and access to up-to-date science education resources from the Eisenhower Network. The Consortium also provides financial support and serves as a "critical friend" to HASP staff in their implementation of science notebooks.

In October 2000, the HASP staff, teachers and administrators from the Huntsville area, and Consortium staff spent six days visiting the El Centro, California, schools, whose inquiry-based science program served as a model for HASP. The highlight of the trip was the opportunity to talk with students about their science notebooks.

In January 2001, El Centro staff came to Huntsville to work with a pilot group of teachers from the eight school districts. The consultants explained how to prompt students to write and how to use the notebooks for assessment. The visitors also held a session for principals and superintendents to garner their support.

The Alabama teachers had many questions for the California teachers. All of the teachers were enthusiastic about using science as a vehicle for improving their students' language skills. Baker, Dreher, & Guthrie (2000) support this use of science.

During spring 2001, HASP and Consortium staff visited the Huntsville classes to observe students using science notebooks, to assist teachers, and to select a cadre of teachers to attend a summer leadership institute. These teachers will conduct workshops for a new group of teachers who will be using science notebooks for the first time.

Evaluation of the effort will be based on student performance on the Stanford 9 test, as well as the students' Alabama Writing Assessment scores. Pressnell notes that "the test data for El Centro indicated a steady climb," and she is eager to see the result of science notebook use with students in Alabama. In addition to increasing students' understanding of science concepts and their writing skills, she hopes that the notebooks will increase learning in other areas, such as reading: "Research has continued to confirm that children comprehend narrative writing at a higher level than expository writing. We feel that if children learn to write in an expository fashion, they will also learn to comprehend expository writing."

References

Baker, L., Dreher, M.J. & Guthrie, J.T. (Eds.). (2000). *Engaging Young Readers.* New York: Guilford.

Saul, W. & Reardon, J. (Eds.). (1996). *Beyond the Science Kit.* Portsmouth, NH: Heinemann.

Best in the Midwest

by Cyntha Pattison, North Central Eisenhower Mathematics and Science Consortium at NCREL

Leadership for the future takes preparation. For more than eight years, the North Central Eisenhower Mathematics and Science Consortium at the North Central Regional Educational Laboratory (NCREL) has served educators throughout the seven states in our region. We have worked in state departments and in school districts, in small rural communities and in large urban centers, in district offices and in classrooms, at meetings of professional organizations and at school board meetings. The relationships we have developed enable us to use our knowledge of research and best practice, and couple that with the collective knowledge of our partners, to offer services and products to help educators face future challenges. Here are just a few examples.

Blueprints CD-ROM and Web Site

The North Central Consortium took the lead in a collaboration with other Eisenhower Regional Consortia and ENC to develop *Blueprints: A Practical Toolkit for Designing and Facilitating Professional Development*. Taking the form of a CD-ROM and a web site (www.ncrel.org/tools/bp/index.html), *Blueprints* is designed as a computer-based resource for experienced as well as aspiring professional developers.

The CD-ROM includes more than 80 activities in four content areas: Planning Professional Development, Crafting Curriculum, Refining Instructional Practice, and Making Assessment Decisions. Activities model the use of approximately 22 interactive group processes. These processes, together with the content and a template for creating a professional development plan, serve as a computer-based toolkit for facilitators. The *Blueprints* web site expands the content of the original CD-ROM with new processes, tools, and resources. The site also maintains web links to use with *Blueprints*.

Both the CD and the web site reflect the Consortium's belief in the importance of continuous, active, and collaborative professional learning as well as our recognition of reflection as an important part of the process. We are committed to continuing to design tools that help facilitators shape professional development to meet the unique needs of their participants.

Promising Curricular and Instructional Improvement Materials (PCIIM)

The PCIIM collection is a collaborative project between the Consortium and the Lederman Science Center at the Fermi National Accelerator Laboratory. The PCIIM collection contains current National Science Foundation curriculum projects and other innovative mathematics and science materials that satisfy the standards-based criteria established for the collection.

Teachers in the states served by the Consortium can review the materials at the Lederman Science Center or attend curriculum showcases cosponsored by the Consortium and its partners throughout the region. The collection is continuously updated so that it offers teachers the most current projects in the nation.

The major objectives of the collection are to provide access to the latest curriculum materials in mathematics and science, and to help committees and individuals from K-12 schools to align curriculum materials with national, state, and district standards. The collection also helps teachers keep informed about current best practice and the latest research pointing to future directions for education.

Ed STAR (Educational Standards, Technology, Applications, and Resources) Web Site

The North Central Consortium has partnered with NCREL and the Minnesota Department of Children, Families, and Learning (CFL) to develop a comprehensive web site (edstar.ncrel.org) for teachers. CFL personnel, SciMathMN personnel, and teachers from throughout Minnesota and across the region joined in this collaboration.

The main purpose of the site is to provide direction and professional development to teachers as they implement Minnesota state standards. The Minnesota Ed STAR site is also a prototype for other states in the region that struggle with all of the issues that surround initiatives to improve student achievement through standards implementation.

Mid-continent: Bringing Native Americans into the Teaching Profession

by Elaine J.C. DeBassige D'Amato and John Ristvey, McREL Eisenhower Regional Consortium for Mathematics and Science

In our region, where many schools serve Native American children, few Native Americans serve as teachers. Haskell Indian Nations University (HINU) and the McREL Eisenhower Regional Consortium for Mathematics and Science are working together to change that. Located in Lawrence, Kansas, HINU is one of several tribal colleges committed to increasing the number of Native Americans certified as teachers.

The Haskell program prepares teachers to work with children of all ethnic heritages. Emphasis is on the inclusion of culture in curriculum and attention to the whole child (body, mind, and spirit). Teachers who graduate from this program are prepared to create their own professional path. They may return to their own communities to teach in a predominantly Native American school, or they may choose to establish themselves in other settings.

The partnership between McREL and HINU is designed to enhance the preservice program in elementary education at HINU by providing ongoing professional development for faculty and students. For example, McREL staff visited the HINU senior class three times during the fall 2000 semester and made a final visit in spring 2001, when the HINU students were completing their student teaching experience.

The partnership covers topics such as thematic units, the national mathematics and science standards, and assessment. Each visit is designed so that students can experience different presentation and teaching styles. Participants take charge of their own learning by creating a personal professional development plan. Throughout the program, we use resources from ENC and the Eisenhower Network such as the Making Schools Work for Every Child web site (equity.enc.org).

Between visits, the students participate in a listserv hosted by EdGateway (www.edgateway.org), a service of the Far West Eisenhower Regional Consortium, also known as WestEd. The conversations on this listserv focus on questions and readings to prepare students for the next site visit. Students are also encouraged to use the listserv to communicate among themselves. The intent is to engage students in electronic communication so they can take this skill with them after graduation.

McREL and HINU plan to refine their partnership based on data collected from graduates. So far the program seems to be working. In the fall of 2000, three HINU seniors reflected on their experiences in a presentation at the annual Kansas Association for Native American Educators conference. The students highlighted their successes and shared how they planned to use the knowledge they had gained from the collaboration.

In years to come, we hope to see a teaching force as diverse as the students our schools serve.

Access Centers Serve the Southwest

by Mary Jo Powell, Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching at SEDL

Whatever other challenges confront science and mathematics educators in the future, a shortage of classroom materials will not be among them. Eisenhower National Clearinghouse has amassed more than 19,000 educational resources in its databases, and new items are added continually. However, in addition to information about resources, teachers need direct experience with materials to determine the most appropriate items for their classrooms.

The Eisenhower Southwest Consortium for the Improvement of Mathematics and Science Teaching (SCIMAST), located at the Southwest Educational Development Laboratory (SEDL) in Austin, Texas, enables teachers to get hands-on experience with some of the best materials available. Through a network of Access Centers spread across its five-state region, SCIMAST supports the identification and acquisition of excellent materials. Located in universities, professional development centers, museums, and public schools, 37 Access Centers now participate in the program. SCIMAST plans to increase the number to 50 over the next few years.

Twice each year, representatives work together in Austin. Each fall, they learn the latest developments from SCIMAST and ENC, share their strategies for working with teachers, and improve their understanding of their critical role in helping teachers make better decisions about materials. During the spring, representatives attend one of four smaller meetings where they review materials around a particular content theme. They also share new techniques for helping teachers use the materials. Each Access Center then selects the materials it will make available to teachers in its region.

Each Access Center is connected electronically to SCIMAST and to ENC. Teachers can search a database of materials available at each SCIMAST Access Center. Some Centers allow materials to be checked out and used in classrooms.

Librarians, higher education faculty, professional developers, and museum personnel all staff Access Centers, and each group brings a unique set of skills to the project. By getting together regularly, Access Center representatives have built a network they can call on for assistance. Librarians, for example, may ask professional developers for suggestions for teacher workshops; in return, they offer a wealth of insight for professional developers on how to catalog and track materials in a lending collection. SCIMAST Access Centers are committed to providing 240 contact hours of professional development and to helping teachers understand and gain access to the highest quality resources on the market.

To find out more about SCIMAST and its Access Center network, check out the web site (www.sedl.org/scimast/accesscenters).

Job-Embedded Professional Development in the Northwest

by Jennifer Stepanek, Northwest Eisenhower Regional Consortium for Mathematics and Science at NWREL

In an era of increasing diversity and accountability, professional development must rise above the traditional model of disconnected workshops and college courses. Teachers in the Northwest are calling for ongoing, classroom-based professional development to meet the challenge of ensuring that all students have opportunities to learn rigorous mathematics and science.

To answer that call, the Northwest Eisenhower Regional Consortium for Mathematics and Science has developed a system of partner sites. This system involves two sites in each Northwest state, each located in a school or district. Intensive professional development is tailored to local needs, and approximately 25 educators are supported at each partner site.

The Consortium's work at each partner site is planned to continue over at least two years. "Working intensively with teachers over an extended period will enable us to provide real-life examples of best practices for instruction and assessment," notes Consortia Director Kit Peixotto. Teachers will have opportunities to learn from one another in a way that supports them as inquirers and constructors of knowledge.

One of the partner sites is unique in that it is a collaboration between two school districts. Parma School District and Marsing School District are located in Caldwell County, just west of Boise, Idaho. At the first partner site meeting, the teachers and administrators from both districts developed a set of common goals for their work with the Consortium.

Teachers from the middle school and high school in each district will be working with Eric Blackford, a science associate at the Northwest Eisenhower Regional Consortium. Val G. Bush, superintendent of the Parma School District, says, "We are committed to improving instruction in Parma, especially in math and science. We have tools and people in place that can make this happen with a little extra help."

Blackford is guiding the teachers in integrating computer use in the mathematics and science curriculum. The teachers are also exploring innovative strategies for block scheduling, project-based learning, cooperative learning, and integrating mathematics and science. Both districts share a need to implement instructional practices to serve a growing population of students learning English as their second language.

Blackford spends approximately four days each month at Parma and Marsing, working with the teachers both individually and as a group. The professional development activities vary according to the teachers' needs. For example, Blackford's first visit included a work session on integrating the curriculum for the whole faculty of Parma High School. There was also a session on integrating mathematics and science for middle school teachers. Blackford observed and modeled in teachers' classrooms and shared resources from the Consortium. At a spring session, teachers from both districts met to learn about and develop strategies for effectively using block scheduling.

Although partner sites are designed to meet local needs, the project is also intended to generate professional development models that other districts can adapt. A long-term goal is to build local capacity so that teachers can sustain their own professional learning over time.

Far West: Earth Systems Science in Utah—and Globally

by Art Sussman, WestEd Eisenhower Regional Consortium for Mathematics and Science Education

Even before there were national standards for science education or benchmarks for science literacy, educators in Utah recognized the need to revise science education. The old Utah Elementary and Secondary Science Cores emphasized disconnected facts, did not encourage student inquiry, and lacked connections to current science and its societal applications.

The WestEd Eisenhower Regional Consortium (WERC) enthusiastically joined a coalition led by Brett Moulding, state science specialist, that included the Utah State Office of Education, school districts, higher education institutions, mentor teachers, and informal science organizations. Over the past seven years, this coalition produced new core documents, disseminated them throughout the state, provided professional development, and distributed print and web-based resources.

Earth systems science is one of the areas where the new documents have pushed the horizon in science education. In the Utah Secondary Science Core, students can now fulfill one year of their high school science requirement by taking a course in Earth systems science. Unlike traditional Earth science, this course provides an interdisciplinary exploration of how our planet works. It reflects the way today's scientists investigate global climate, the atmosphere, or the web of life by combining tools and ideas from many scientific disciplines including geology, biology, chemistry, physics, and computer science.

WERC provided two resources to aid in teaching this new course. We helped obtain and implement a grant from the Environmental Protection Agency that supported student engagement in local-action projects. Students investigated creeks, invasive species, wetlands, and other local contexts where they could apply what they had learned in the course.

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The development of the other resource resulted in part from my experience in helping teachers and students learn about Earth systems science. Since this is a relatively new interdisciplinary field, most educators, including environmental educators, did not learn about our planet this way.

I discovered that teachers, students, and environmental educators all responded positively to a systems-based intellectual framework that focuses on Earth's matter, energy, and life. (See Figure 1.) In this framework, we compare how Earth is essentially a closed system for matter, an open system for energy, and a networked system for life.

We can use this framework to understand essentially all environmental issues. For example, the issue of global climate change results from alterations that we are making in Earth's matter cycles, particularly the carbon cycle. The greenhouse gases that we emit alter Earth's energy flows, causing heat to remain longer in the Earth system. The potential resulting climate changes will impact Earth's web of life.

My experience sharing these ideas with teachers and students and in informal education settings motivated me to write *Dr. Art's Guide to Planet Earth*, co-published by WestEd and Chelsea Green Publishing Company. A complementary web site (www.planetguide.net) includes lesson plans, animations, and experiments.

Editor's Note: The Children's Book Council in collaboration with the National Science Teachers Association recently named Dr. Art's Guide to Planet Earth *as an Outstanding Science Trade Book for Children with the added recognition as a Selector's Choice by the judges.*

THREE EARTH SYSTEMS		
MATTER	**CLOSED SYSTEM**	Each of the elements vital for life exists on Earth in a closed loop of cyclical changes.
ENERGY	**OPEN SYSTEM**	Earth receives a constant input of energy from the sun, and this energy leaves the Earth system as heat flowing to outer space.
LIFE	**NETWORKED SYSTEM**	A vast and intricate network of relationships connects Earth's organisms with each other and with the cycles of matter and flows of energy.

Figure 1

Pacific Algebra Network: A Teacher's Perspective

by Barbara Dougherty, Curriculum Research & Development Group, University of Hawaii, for Pacific Eisenhower Mathematics & Science Regional Consortium

Imagine walking into a classroom to the following scene:

> "We're ready to present," Group Three says to the teacher.
>
> "Okay, let's have the speaker and note taker go to the board," the teacher replies.
>
> Kalani and Junior go to the front of the room. Kalani begins putting the solution to the problem on the board while Junior explains how they solved the problem, "First, we tried guess-and-test. That worked but it took us a long time. Clarence said to try to make a table. We did and then we could find the solution."
>
> Kalani adds, "We saw some patterns in the table. If the number is negative, the value of the expression is positive. If the number is positive, the value is negative."

This sort of learning is happening in algebra classes at middle and high schools that are part of the Pacific Algebra Network (PAN). PAN is a collaborative project among the Pacific Eisenhower Mathematics and Science Regional Consortium and PRELStar, both at Pacific Resources for Education and Learning (PREL) and the Curriculum Research & Development Group (CRDG) at the University of Hawai'i.

This project focuses on using an algebra curriculum (*Algebra I: A Process Approach*, 2001) as the basis for changing teacher practice and boosting student learning. Participants complete a two-week professional development institute in the summer and receive follow-up support during the school year. Follow-up includes site visits, videotapes of classes with a master teacher, and an Internet forum. A CD-ROM containing video clips, sample documents, and representative student work is currently under development.

Martina Basilius of Koror, Palau, teaches at Palau High School and is a second-year user in the program. She describes her experience:

> My students come from 18 elementary schools with different mathematics programs. The big challenge is to find out if these students understand the relationships among numbers, properties, and operations. We normally spend two weeks to clear these obstacles before we actually begin our journey.

> A few students drop the course because they think it will be too difficult. But for those who remain, the result is marvelous. Tremendous changes and improvements begin to show in their work. Even those who talk incessantly in class begin to pay attention.
>
> Sometimes while I am shopping, students who happen to be in the same store will come over to me. With bright eyes and happy faces, they tell me they have found solutions to the problems that were assigned as homework. They want me to hear how they did it before we go to class the next day.

PAN involves a change in teaching practice. Basilius explains:

> Before, I stood in front of the class and lectured most of the time. This has changed. Now, student groups do the work. Within each group, there is a designated speaker and a note taker. They are given 15 minutes to discuss their work before doing their class presentation. Each week, the speaker and note taker change so that everyone in the group shares the work and also learns to speak about the problems.
>
> My job is to introduce new words, clarify the problem, and turn over the class to students. I have time to ask questions if students leave out important parts. Each student is important and must be heard. For those who are slow, I allow them to listen to others before they present their work. They are often ready to volunteer for the first presentation the next day.

Basilius concludes:

> When I attended the workshop in July 1999, I was like my students. I said, "This is too hard; I cannot handle it." Every time I tell this to my students, they laugh. But I am afraid that oftentimes, it is we, the teachers, who are limiting the learning of the students.
>
> Now I can say that PAN is practical. I am able to construct a math situation, see it, and share it with others.

For information on algebra materials or professional development, contact CRDG at the University of Hawai'i, 800-799-8111 or email Barbara Dougherty (bdougher@hawaii.edu).

Reference

Rachlin, S., Matsumoto, A., Wada, L. & Dougherty, B.J. (2001). *Algebra I: A Process Approach*, 2nd Edition. Honolulu, HI: University of Hawai'i, Curriculum Research & Development Group.

The Communication Revolution

Communicating across cultures, across time, and across the country has been revolutionized through modern technology. Teachers can now rely on far-distant peers for support and cooperative reflection to improve their practice.

Photos by Susan Boone

by Susan Boone, St. Agnes Academy, Houston, Texas.

Have you ever wondered whether the way you teach is the best way? There is no lack of debate regarding methods in mathematics education. Decisions must be made for algorithms vs. discovery, back-to-basics vs. problem solving, or teaching through lectures vs. group work. As a mathematics teacher, I often feel pulled and stretched to go in several directions at once.

In 1998, I was selected by the Math Forum to be a part of a group of seven mathematics teachers from around the country who work together in a National

Science Foundation project, hosted by TERC, called Bridging Research and Practice (BRAP). We collaborate jointly and with researchers from Math Forum, an online math resource originally funded by the National Science Foundation, to address the questions that so many math teachers ask themselves daily.

During the last year, the teachers and researchers of the BRAP Project have spent time together face-to-face in workshops, participated in conversations through email and virtual meetings, read research articles online and in print, shared videotapes of our classrooms via the Internet, and talked about our teaching. Much of the communication we engaged in would never have been possible without today's technology. Through our discourse, we have built a trust between one another that has allowed us to share our successes as well as our failures.

For example, each of us teachers presented a similar problem in our classes:

Experiment with Volume (math.rice.edu/~lanius/Geom/cyls.html)

Form two cylinders from a rectangular piece of paper, one by joining the long sides, one by joining the short sides. Which of these cylinders will have greater volume, or will they hold the same amount?

Via the Internet, we studied video clips of students in each other's classrooms, explored teaching practices, and discussed how to encourage mathematical thinking. As we shared videos made in our classrooms of our teaching practice, our confidence sometimes gave way to doubt, raising the question: "How do I know if I'm doing this right?"

Through discussion, we have learned that improvement in teaching is never finished, but collaboration, communication, and reflection on teaching help to make us more effective teachers in the classroom. Technology lets us capitalize on our communication by making possible midnight chats online, email messaging, and digital video.

The results of our research have developed into an online videopaper, Encouraging Mathematical Thinking: Discourse Around a Rich Problem. (mathforum.com/brap/wrap) Other teachers who are interested in using collaboration, communication, and reflection as tools for professional growth are invited to join in our conversation. There is a link to an online discussion from every page of the videopaper.

In addition, we encourage professional development staffs and teacher educators to encourage their constituents to become involved in our collaboration. We invite you to join us and teachers from other classrooms to use technology to its fullest potential to deepen our understanding of mathematics, teaching, and learning.

Susan Boone teaches Algebra 1 and 2 at St. Agnes Academy, an all-girls Catholic high school in Houston. She is currently working on BRAP with the Math Forum and is a master teacher for GirlTECH, a technology-training course that also explores innovative teaching strategies that impact equity in the classroom. For an article about GirlTECH, see the online version of Volume 7, Number 4 of this magazine (enc.org/focus/equity).

Suggested Readings:

Ball, D. L. (1999). Working on the Inside: Using One's Own Practice as a Site for Studying Mathematics Teaching and Learning. In A. Kelly & R. Lesh (Eds.), *Research Design in Mathematics and Science Education.* Norwell, MA: Kluwer.

Chazan, D. & Ball, D. (1995). Beyond Exhortations Not To Tell: The Teacher's Role in Discussion-Intensive Mathematics Classes, National Center for Research on Teacher Learning, Michigan State University. ncrtl.msu.edu/http/craftp/html/cp952.htm

Countryman, J. (1992). *Writing to Learn Mathematics: Strategies That Work.* Portsmouth, NH: Heinemann.

National Council of Teachers of Mathematics. (1991). *Professional Standards for Teaching Mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics.* Reston, VA: Author.

Schifter, D. (1996). *What's Happening in Math Class? Reconstructing Professional Identities* (Vol. 2). New York: Teachers College Press.

Schoenfeld, A. (1987). What's All the Fuss about Metacognition? In A. Schoenfeld (Ed.), *Cognitive Science and Mathematics Education* (pp. 189-215). Hillsdale, NJ: Lawrence Erlbaum Associates.

JUMP ONLINE

Susan Boone and BRAP have both been honored with ENC's Digital Dozen Award. The online version of this magazine provides direct links to ENC's Digital Dozen and all the web sites mentioned in this issue (enc.org/focus/horizons).

Learning Mathematics and Science in a Virtual High School

Virtual schools come in many guises. In Maryland, the emphasis is on online collaboration to solve real-world problems.

by **Mary Ellen Verona and Susan Ragan, Montgomery Blair High School, Silver Spring, Maryland**

The Maryland Virtual High School of Science and Mathematics (MVHS) was created in 1994 by teachers who wanted to share the experience they had had in a special summer computational modeling program (SuperQuest). The goal was to enable other science teachers and their students to use computer modeling to solve real-world science problems. Such activities emulate the work of scientists and meet the recommendation of a National Science Foundation report: "Computational modeling ideas and activities should have a key and central role throughout the science curriculum—not peripherally, and not only as a part of a special or optional course" (Roberts, 1995).

Current MVHS leaders consider themselves first and foremost classroom teachers. The project also relies on the perspectives of teacher educators, instructional designers, scientists, and cognitive scientists. University and community college educators have collaborated with practicing MVHS teachers to extend MVHS activities into courses for inservice teachers.

MVHS does not offer courses for high school credit on the web (see sidebar for a list of organizations that do). Instead, we offer a place where teachers can grow in their profession and can share their work with others. Students participate in MVHS activities, such as the Maryland earthquake simulation (see box), through their teachers.

The CoreModels Project

One example of the work of MVHS is the CoreModels Project, which was designated one of seven promising technology projects by the U.S. Department of Education in September 2000. The CoreModels Project began in 1997 to create modeling activities and provide the support teachers need to implement them in the classroom.

Teacher support includes content instruction, guided practice with computer skills, ideas for engaging students, and discussion of strategies for countering student difficulties. In addition to conducting traditional workshops, MVHS teacher leaders visit their peers on site to help in their first implementation attempts and for subsequent debriefing sessions.

CoreModels curriculum pages for physics, biology, earth science, and chemistry are available on the MVHS web site. More than 30 activity packets cover topics such as simple kinematics, earth energy balance, glucose/insulin, and radioactive decay. The packets consist of the computer model, teacher guides, and student worksheets, all of which are available for download. Supplementary information is also provided.

Teacher-Developed Materials

A vital component of MVHS is the role of teachers in developing student materials, including web simulations, called WebSims. MVHS teachers use tools such as Biology Workbench, ChemViz, and the River-WebSM to design, field-test, and refine instructional materials.

Working with National Computational Science Alliance (NCSA) partners, MVHS teachers developed Water Quality Simulator (WQS), a WebSim that supports student inquiry

An Earthquake in Maryland?

Although Maryland rarely has earthquakes, Maryland Virtual High School simulated one using computational techniques. Each school, acting as an independent seismograph station, downloaded data representing seismic waves generated by the fictitious earthquake. By analyzing graphs of the data, participating students were able to determine the distance between the school and the epicenter.

Students exchanged their data via email and then posted their answers on the web page set up for this project. This activity challenged the students to work together over space and time. It also gave them an authentic reason to value accuracy in computation, to apply their skills to maps and scales, to master graph interpretation, and to use computers for communication and visualization. Sharing their work with other schools made them value the quality of that work. For access to the earthquake project, see the web site (isaac.williamsport.wa.k12.md.us/~ctrout/quake.html).

Students have joined with peers statewide in a variety of other projects ranging from an investigation of differences in local water quality measurements to a collaboration to determine the circumference of the Earth by replicating Eratosthenes' experiment.

into watershed dynamics. The simulator integrates modeling and visualization with exemplary, web-based learning materials linked to national and state standards for high school science.

WQS includes a digital notebook that allows teachers to provide their own structure through directions, increasingly complex questions, and links to other resources. After the user logs on, a map of the archetypal watershed appears. Water quality monitoring stations located throughout the watershed are shown. The user may click on the map to investigate any sub-watershed.

MVHS teachers have been involved in creating several other WebSims in addition to WQS. The Carbon Cycle WebSim, for example, can help students understand the concepts of feedback and equilibrium and how changes in the rates of respiration represented by the burning of fossil fuel affect the Earth. This simulation is available through the web site of MVHS partner Shodor Education Foundation (www.shodor.org). We have also taken the initial steps in creating enzyme and orbit WebSims, which are available on the MVHS web site.

Evaluating the Benefits of MVHS

In harmony with the standards for professional development found in the *National Science Education Standards* (1996), MVHS teachers work together in a collegial environment fostered through summer workshops, email exchanges, and web-based sharing of materials. By reflecting on their own teaching practice, participants facilitate change in science education, integrate theory and practice in school settings, and produce knowledge about learning and teaching.

An important part of the evaluation effort is documenting the effect of computer modeling activities on student learning. Through the use of a variety of assessments—video analysis of student dialogue, constructed-response questions scored with the Maryland Science Rubrics, and end-of-semester exams—we can examine the impact that MVHS materials and practices have on student performance. Teachers can also diagnose conceptual difficulties by looking carefully at how their students express their understanding through written answers to MVHS assessments.

This knowledge is driving changes in classroom instruction. As a result of working with computer models, teachers report that they are asking questions that require students to analyze more complex situations.

The 1999 CoreModels Evaluation Report records this teacher comment:

> *Many students are showing increased enthusiasm for and ability to predict dynamic trends or outcomes. I think the real-time experience of proposing model changes, predicting results, and then immediately learning the effects is a very powerful way to build student interest and skill in this area. Several students have "gotten" certain algebraic relationships for the first time ever, and others have gotten over their "graphiphobia."*

Comments like this, taken along with results of the formal assessments, encourage us to continue to develop MVHS programs and to reach out

JUMP ONLINE!

Come to the Maryland Virtual High School web site (mvhs.mbhs.edu) for all the details about this program. For direct links to this and all the web sites mentioned in this magazine, come to the online version enc.org/focus/horizons

Virtual High Schools That Offer Credit

Unlike MVHS, many virtual high school programs provide high school course credit to students through online interaction.

Choice 2000 (www.choice2000.org), one of the original charter schools in California, bills itself as "the first totally public online school in the United States." It is free to students living in Riverside, San Bernardino, San Diego, Imperial, and Orange counties. California students living outside these counties are prohibited from attending, but other students worldwide pay tuition to attend. Students meet weekly in synchronous sessions. Advanced mathematics and science courses are not included among the offerings listed on the web site.

CyberSchool (CyberSchool.4j.lane.edu) does not offer a full curriculum, but enables schools to provide options to motivated students. Recent offerings in science include general biology, DNA and genetics, and marine ecosystems. In mathematics, CyberStat I and II are advertised as preparing students to take the AP statistics exam. The school's Math on the Web program includes a series of minicourses featuring topics such as formulas and spreadsheets, systems, random choices, matrices, and exponential growth.

Utah Electronic High School (ehs.uen.org) offers a wide range of courses including many in math and science. Courses are available through broadcast television, two-way video, independent study, the Internet, satellite, and videotape. Students enroll to make up lost credit or to take courses not offered at their school. Many courses are free to Utah students. Others pay $100 per semester.

The Virtual High School (vhs.concord.org/home.htm) developed by Concord Consortium through funding from the U.S. Department of Education has enrolled more than 3,000 students from 250 schools in 150 online courses. Schools participate through a reciprocal arrangement in which one faculty member must teach an online course. When government funding ends in January 2002, VHS will become a nonprofit organization. Schools will pay $6,000 a year to enroll 20 students in course offerings. Math courses range from AP calculus, to fractals, to the history of mathematics. Science courses include geology, genes and disease, environmental chemistry, and integrated mechanical physics among many others.

to more teachers and students throughout our state.

Mary Ellen Verona is the principal investigator and project director of the MVHS CoreModels program. After teaching computer science, mathematics, and science for more than 15 years, she wrote the proposal that funded the establishment of MVHS. She is a Ph.D. candidate in climate dynamics and global change at George Mason University and conducts research at the Center for Ocean Land Atmosphere Studies.

Susan Ragan, instructional specialist with Montgomery County Public Schools, has more than 20 years experience teaching high school mathematics and computer science. For the past seven years, she has played an integral role in MVHS, leading teacher workshops, developing instructional materials, measuring student learning, and participating in program evaluation.

Maryland Virtual High School supporters include representatives from 14 Maryland school districts, the Maryland State Department of Education, the Maryland Association of Science Teachers, Prince George's Community College, Montgomery College, University of Maryland College Park, Center for Children and Technology, Shodor Education Foundation, and the National Computational Science Alliance (NCSA).

References

National Research Council. (1996). *National Science Education Standards.* Washington, DC: National Academy Press.

Roberts, N. (1995). *Setting a Research and Planning Agenda for Computer Modeling in the Pre-College Curriculum.* National Science Foundation, Final Report: NSF RED-9255877.

Friedman, W. & Culp, K. (1999). *CoreModels Evaluation Report.* New York: Center for Children and Technology.

Cable in the Math and Science Classroom

The technology may not be new, but teachers all over the country demonstrate how Cable in the Classroom helps them face current challenges such as high-stakes testing and new educational standards.

by Terri Payne Butler, Lexington, Massachusetts

First developed by cable television companies in 1989 as a free public service, today Cable in the Classroom reaches 86 percent of all U.S. students (Cable in the Classroom Online, 2000). Cable in the Classroom provides teachers all over the country with programming and resources, including *Cable in the Classroom* magazine, to help them meet the latest educational standards for nearly every school subject, including mathematics and science.

Photo by Jym Wilson © Cable in the Classroom

Cable in the Math Classroom

Kimberly K. Loomis, mathematics supervisor for Lyal W. Burkholder Middle School in Henderson, Nevada, has been a high school math teacher for 10 years. She knows from a decade in the classroom that today's teacher needs to pack every math lesson with as many concepts as it will carry.

"Before adoption of the 1998 Nevada state standards, we often focused on a single concept at a time, and we knew that if we didn't manage to teach every one by the end of the year, the students would go on to learn them

Photo by Sam Kittner © Cable in the Classroom

in high school," Loomis says. "Now we're all moving so fast that teachers need to be able to hit several concepts in one lesson."

Loomis used Sports Figures, an ESPN2 cable television series, to capitalize on the skills of professional athletes to illuminate math and science concepts.

"Statistics is one of the areas that students nationwide have difficulty with. They often confuse mean, median, and mode," Loomis says. "I used the Sports Figures episode with WNBA-star Ruth Bolton-Holifield to help my students learn to decipher and calculate statistics. We looked at how and why one day's game changes statistics, then added a second game, then five more, and calculated the statistics each time."

Another episode brought bungee jumping into the classroom. "The program used a great formula that involved the bungee jumper's weight, the length of the bungee cord and the distance between the starting point and the ground. Students need to learn how to use formulas and plug in variables—and the program showed them exactly how that's done in a real life situation."

Loomis, who presents workshops on using video in the classroom, says that some teachers are surprised to find Cable in the Classroom programming that can help them teach math. "Video can create an enthusiasm for learning in students, and often their understanding is brought along faster when they are enthusiastic about the teaching method. Over time they could get the material in other ways, but this method speeds up the process. And if we lectured or drilled every time, we would lose out on the mathematical process standards—communication, problem solving, reasoning, and connections."

Loomis stresses the efficacy of using only short video clips. "Showing an entire video is not the best way to get the job done," she says. "When you pause a video or only show a part, kids are more focused. You see the excitement level in the classroom go up and that excitement is contagious."

In the Science Classroom

At Shade Central City Elementary School in Cairnbrook, Pennsylvania, video is an important supplement to Kathy Shippy's science lessons. For Shippy, who teaches fourth, fifth, and sixth graders, Cable in the Classroom programming is a multi-purpose tool. "I like to use it as a motivator," she says. "Sometimes it's an introduction to a topic; sometimes it's a reinforcement; sometimes I use it to add information. When we were studying Newton's laws of motion, I used the 'Newton's Hat Trick' episode of Sports Figures."

"We went over the laws, but the program explained them in a way that I couldn't. It gave a lot of examples and applied the concepts to real life." The movement of a hockey puck across the ice was at the core of this particular episode, illustrating Newton's laws of motion. That's the kind of knowledge—"observe and describe different types of force and motion"—that Shippy says Pennsylvania students will need to bring to the state's standardized tests.

"Because the program has humor and because there are athletes involved, the kids are attentive right from the beginning," she adds. "It's a starting point for our science explorations. I used another Sports Figures episode that focused on kayaking for a lesson on density and buoyancy. It worked perfectly with a hands-on experiment where we designed boats out of clay and foil and then filled them with marbles until they sank."

Shippy continues, "We stress learning concepts and gaining experience. The best way for students

More About Cable in the Classroom

Cable in the Classroom is a public-service initiative of the cable television industry, providing more than 540 hours of commercial-free educational programming each month. CIC also announced in July of 1996 that it will provide consenting K-12 schools with a free cable modem and free high-speed Internet service. Teachers wishing to learn more about CIC's math and science programming and services may call (800) 743-5355 or visit the web site (www.ciconline.org). There they will find links to support materials, lesson plans and standards, as well as information on *Cable in the Classroom* magazine.

to learn about farm animals certainly would be to visit a farm, but even if they were able to do that, it would take them a lot of observation time to learn what they need to know. One of the good things about a video is that in 15 minutes they can learn about farm animals in a concentrated, organized way, when it might otherwise take them two hours to gain the same information."

Eighth-grade teacher Elaine Miller, who like Loomis and Shippy was originally interviewed for *Cable in the Classroom* magazine, has also found that cable programming makes it easier to reach her students at Charlotte, North Carolina's Management School. Many of her students are tactile or auditory learners or read below grade level, and they need to access information in nontraditional ways.

Miller used a segment on volcanoes from The Learning Channel's Elementary Classroom to ignite excitement in her classroom. She followed the video with an experiment in which students made a volcano from potting soil and then concocted an eruption with baking soda and vinegar. "The video piqued their interest and gave them a sense of what to look for during the experiment," Miller says. "They learned how volcanoes explode and how lava flows, and then got to see for themselves what determined where the lava flowed and how fast. It made science real for them."

Photo by Jym Wilson © Cable in the Classroom

At Walberta Park School in Syracuse, New York, librarian Lynn Spencer worked with three teachers and 70 third graders to make children's passion for pets do double duty as a cross-curricular science and language arts project. She built student understanding by using segments from Nickelodeon's Nick News on the American Society for the Prevention of Cruelty to Animals, puppy mills, and stolen pets.

Spencer thinks videos offer some students a higher level of information than they might gain through books and magazines. "In the third grade, children are reading at a variety of levels, and often what they need to know is not found in books at their reading level," she says. "The videos allowed them to access information with higher-level concepts and more advanced vocabulary."

Beyond the Classroom

Michael Crowell, a science teacher at Mainland Regional High School in Linwood, New Jersey, found that Cable in the Classroom programming could also inspire his students to reach beyond the classroom with what they'd learned. Crowell used CNN Newsroom's special reports on Florida's endangered manatees to focus studies on environmental literacy.

"One student had swum with the manatees," Crowell says. "I teach that most environmental problems are solvable, and this student wanted to come up with an action plan to help them. We worked in our school's ecology club to raise money and then sent it to a Florida group working to save the manatees. In this day and age, when you really have to vary your instruction, when you can't rely only on lecture, discussion, and reading to get your point across, cable television is a tremendous resource."

During the 1990s, many teachers found that the new technology of a well-produced video designed for classroom use could reinforce concepts, make cross-curricular connections and supplement textbooks—all the while engaging and intriguing students. Because Cable in the Classroom continues to provide up-to-the-minute programming on topics in today's news, it continues to be valuable technology to educate America's students.

Terri Payne Butler, a freelance writer from Lexington, Massachusetts, reports on education and technology for national publications and web sites. With a background producing children's television programming, Butler has written several articles for Cable in the Classroom *magazine.*

Reference

All About CIC. (2000). Alexandria, VA: Cable in the Classroom. Retrieved May 4, 2001: www.ciconline.com/section.cfm/2

Focus on the Collection

This section presents highlights from the full ENC record for exemplary resources selected to illustrate this issue's theme.

ENC's Collection and Catalog

ENC's collection of mathematics and science resources is the most comprehensive in the nation. 20,000 resources are housed in our national repository, with new items arriving daily. We collect materials from federal and state agencies, commercial publishers, professional organizations, school districts, and individuals. The collection includes print materials, software and CD-ROMs, kits and manipulatives, along with hundreds of excellent Internet sites.

All materials are cataloged by ENC, and the catalog records are searchable from our web site (enc.org). Part of each catalog record is a detailed description of the resource written by ENC experts in mathematics and science education. These descriptions are not evaluative reviews, but the online record does include references to reviews, awards, and other evaluative materials.

This Is Not Your Parents' Classroom!

by Carol Damian and Terese Herrera, ENC Content Specialists

No matter where you look in the United States, K-12 classrooms have changed dramatically over the last 30 years. Students come from around the world with different backgrounds, goals, and abilities. The teacher is now doing multiple tasks, learning new things every day, and being held accountable in different and exacting ways.

Computers and related technology are evident in today's classrooms, where we see teachers and students working side-by-side to discover how to effectively use these tools to enhance learning. Teaching and learning are intertwined, and both are moving ahead toward more change at an awesome speed.

Classroom management has a whole new look—and continues to change as teachers fine-tune their roles as classroom facilitators instead of the sole providers of information, allowing students an important voice in the teaching-learning process.

School superintendents and principals are not only educators but also business managers, political lobbyists, and public relations people—often distanced from academics and actual classroom activities.

No, this is not your parents' classroom. But wouldn't our parents be proud to see the classroom teacher and student of today learning and experiencing things that were only the stuff of dreams a few years ago?

In today's mathematics and science classrooms, we're truly looking toward new horizons—ways to keep pace with change and to provide solid, relevant learning opportunities. As we scanned these new horizons, we searched for materials from the ENC Collection that tomorrow's teachers and students could use to chart their way.

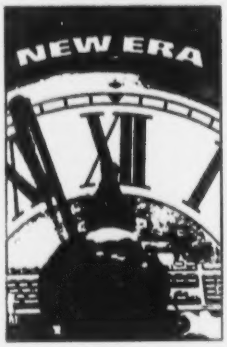
For this Collection Section, we targeted resources in the areas of professional development and teaching strategies. You will find materials on classroom practice, curriculum, and technology that we consider relevant to educators entering this era of new possibilities. The selections as a whole offer a thoughtful vision for math and science classrooms now and into the new horizons.

Please note that our selections are based on items found in the ENC total collection of approximately 20,000 math and science educational materials. Some items are print materials; others are CD-ROMS, activity kits, videotapes, or web sites. Whatever the medium, the items chosen are those we consider to be exemplary, based on the New Horizons theme, and worthy of your examination, discussion, and reflection. It is impossible to include here all of the exemplary materials that would fit the "New Horizons" theme, so we invite you to peruse ENC's web site (enc.org) to gain further insight into what is available for our forward-looking classrooms of today—and tomorrow.

BEST COPY AVAILABLE

Featured Resources

The Leading Edge in Classroom Practice



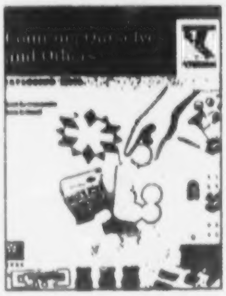
62 Atlas of Science Literacy (K-12)
62 Designs for Science Literacy (K-12)
62 Principles and Standards for School Mathematics: E-standards (PreK and up)
63 Learning Mathematics for a New Century (K-12)
63 Education in a New Era (K-12)
63 Assessing Science Understanding: A Human Constructivist View (K-12)
63 Balanced Mathematics Assessment for the 21st Century (K-12)
64 Math-Ed-Ology: A Multimedia Approach for Improving Math Instruction for Elementary Teachers (K-5)
64 Using the Learning Cycle to Teach Physical Science: A Hands-On Approach for the Middle Grades (5-8)
65 Algebraic Thinking Math Project (ATMP) (3-8)
65 Illuminations: Principles and Standards for School Mathematics (PreK-12)
65 Selecting Instructional Materials: A Guide for K-12 Science (K-12)
66 Mapping Biology Knowledge (8-12)
66 Crocodile Chemistry (9-12)
66 A Private Universe Project in Mathematics: A Professional Development Workshop for K-12 Mathematics Teachers (K-12)
66 Learning and Memory: The Brain in Action (K and up)
67 Brain-Compatible Science (K and up)
67 BrainConnection.com (PreK-12)
67 How People Learn: Brain, Mind, Experience, and School (PreK and up)
68 Young Mathematicians at Work: Constructing Number Sense, Addition, and Subtraction (PreK-3)
68 Mathematical Modeling in the Environment (9 and up)
68 Action, Talk and Text: Learning and Teaching Through Inquiry (K-12)
69 Learn and Live (K-12)

New Directions in Curriculum: Mathematical Modeling

69 Growth Patterns (6-9)
69 The Shape of Space (6-10)
70 Building Formulas (7, 8)
70 The Art and Techniques of Simulation (8-12)
70 Mathematical Modeling: Using Graphs and Matrices (9-12)
71 Spiral Shapes and Mathematical Models (9-12)
71 A Watched Cup Never Cools: Lab Activities for Calculus and Precalculus (10-12)

New Directions in Curriculum: Data Analysis

71 Counting Ourselves and Others: Exploring Data (K)
72 Teach-Stat Activities: Statistical Investigations (3-6)
72 Data: Chances Are (6-9)
72 Samples and Populations: Data and Statistics (8)
73 The Titanic: What Can Numbers Tell Us of Her Fatal Voyage? (9-12)
73 Seeing Statistics (10 and up)



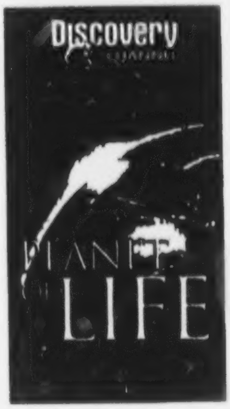
New Directions in Curriculum: Chaos and Fractals

73 The Future of Mathematics: Ferns & Galaxies (K-8)
74 A Fractals Lesson for Elementary and Middle School Students (4-8)
74 Chaos: A Toolkit of Dynamics Activities (7-12)
74 Fractals: Exploring Its Simplicity, Beauty, and Mathematics (9 and up)

Curriculum That Addresses Current Issues in Science

74 Energy Quest: Energy Education from the California Energy Commission (K-12)

75 NASAexplores: Express Lessons and Online Resources (K-12)
75 EPA Global Warming (5 and up)
75 Envision, Explore, Engage: An Interactive Science Experience (6-12)
76 Evolution's Next Step (6-12)
76 The Search for Clean Air (6-12)
76 Critical Issues Forum (CIF): Students and Teachers Examining the Nuclear World (6 and up)
76 Life: The Search for Life on Venus and Mars (7, 8)
77 Communities on the Prairie: Exploring Sustainability (9-12)
77 Fetal Alcohol Syndrome: Maternal Responsibility for Health of Fetus (9 and up)
78 World Population: A Graphic Simulation of the History of Human Population Growth (9 and up)
78 Chances' Choices (10-12)
78 Industrial Systems of Tomorrow: Finding Sustainability Through Natural Cycles (10 and up)
79 Water on the Web (10 and up)



Innovative Science Instruction

79 Literature and Science Breakthroughs: Connecting Language and Science Skills in the Elementary Classroom (K-6)
79 KidScience (5-8)
80 CORD Biology: Science in Context (9-12)
80 Holt Science Spectrum, a Physical Approach (9-12)
80 Virtual Labs and Simulations: Great Websites for Interactive Learning (9-12)
80 Unseen Life on Earth: An Introduction to Microbiology (9 and up)
81 Environmental Science: Earth as a Living Planet (10 and up)

Integrating Technology

81 National Educational Technology Standards for Students: Connecting Curriculum and Technology (K-12)
81 Engines for Education (K-12)
82 Windows on the Future: Education in the Age of Technology (PreK and up)
82 Technology, the Learning Process and a Vision for the Future (K-12)
82 Technology for the Teaching and Learning of Science (K-12)
83 Young Children Using Calculators (PreK-3)
83 Digital Divide Network (K and up)
83 The Educator's Brief Guide to the Internet and the World Wide Web (K-12)
84 The Teacher's Complete and Easy Guide to the Internet (PreK and up)
84 StudyWorks! Online (K-12)
84 The Copernicus Education Gateway: Harnessing the Internet for the K-12 World (K-12)
84 Virtual High School: Bringing Innovative Education to the World! (9-12)

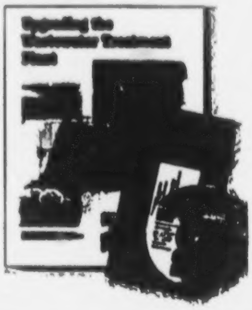
21st Century Tech Tools

85 Filamentality: Helping You Add Your Own Filament to the Web of Learning (K-12)
85 Mission to Planet X (3 and up)
85 Let's Do Math: Tools and Things (4-12)
86 Calculator Based Laboratory 2 (6-12)
86 The Geometer's Sketchpad, Student Edition (7-12)
87 DataStudio: A Tool for ScienceWorkshop (9-12)
87 Derive 5: The Mathematical Assistant for Your PC (9 and up)
87 Fathom Dynamic Statistics Software (9 and up)
87 TI InterActive! Integrated Computer Software for Math and Science (9 and up)
88 Mathematica (11 and up)

Engaging Students with Technology

88 My Body (Primary) (K-3)
88 Technology Tools for Young Learners (K-3)
89 Teaching Science with the Internet: Internet Lesson Plans and Classroom Activities (K-6)
89 CIESE Online Classroom Projects (3-12)
89 Safe Water (5-8)
90 Shape Makers: Developing Geometric Reasoning with the Geometer's Sketchpad (5-8)
90 Manipula Math with JAVA (5 and up)
90 44 Internet Lesson Ideas for Science Classes (6-12)

90 Concepts in Algebra: A Technological Approach (8-10)
91 Transforming Functions to Fit Data: Mathematical Explorations Using Probes, Electronic Data Collection Devices, and Graphing Calculators (8-12)
91 ExploreMath.com (8 and up)
91 Biology Lessons for Prospective and Practicing Teachers (9-12)
91 Modeling Motion: High School Math Activities with the CBR (9-12)
92 Rethinking Proof with the Geometer's Sketchpad (9-12)
92 Upgrading the Wastewater Treatment Plant (9-12)
92 Water Quality with Computers Using Logger Pro (9-12)
93 Advanced Algebra Through Data Exploration: A Graphing Calculator Approach (10-12)

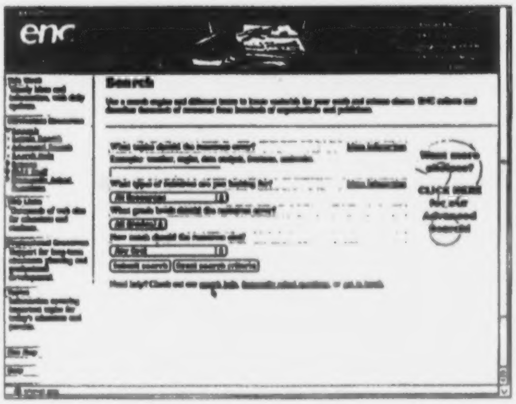


For Further Reading

93 Building a Workforce for the Information Economy (11 and up)
94 The Children's Machine: Rethinking School in the Age of the Computer (K-12)
94 In Accord with Nature: Helping Students Form an Environmental Ethic Using Outdoor Experience and Reflection (6-12)
94 Life by the Numbers: Educational Modules (7-12)
94 Song of the Meadowlark: Exploring Values for a Sustainable Future (7 and up)
94 Symbolic Manipulation by Computers: Information, Ideas, and Implications for Mathematics Teaching (8 and up)

Searching the ENC Collection of Resources

The resource descriptions printed in this magazine are abbreviated versions of the full catalog records available online. You can access ENC's vast collection of curriculum resources by visiting ENC Online (enc.org).



To find the online record for resources featured in *ENC Focus*:

The easiest way to browse the online records of resources featured in an issue of *ENC Focus* is to go to our web site (enc.org) and select the link in the top right corner to ENC Focus Magazine. Select the title of the appropriate issue, then scroll down to the Focus on the Collection section. Finally, follow the links to the records of your choice.

To find other resources:

When you visit ENC Online (enc.org), the Curriculum Resources section in the left navigation bar offers both a simple and an advanced search with help features for each. The advanced search allows you to choose particular subject words, grade level, cost, and type of material to find exactly what you need.

For example, materials for this magazine were found through the use of subjects such as issues in mathematics/science; technology; mathematics/science standards; teaching and learning; and WebQuests.

Also in the Curriculum Resources section is the Browse option. Find the subject you are interested in. Once a first page of results is returned, you can use the "Customize using advanced search" feature to further limit your search.

Additional assistance is available online (enc.org/resources/search/help) or by contacting the ENC Information Services staff by email (library@enc.org) or phone (614) 292-9734.

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The Leading Edge in Classroom Practice

Atlas of Science Literacy

Grades K-12
2001
Author: American Association for the Advancement of Science, Project 2061

Project 2061 developed this book as one of a coordinated set of tools designed to help educators understand and use specific goals for student learning. It presents a collection of strand maps that show the development of students' understanding of the ideas and skills that lead to literacy in science, mathematics, and technology. A strand map focuses on a topic important for literacy and displays relevant benchmarks at all grade levels. The book may be used for many purposes, including designing curriculum, planning instruction, and preparing teachers. The chapter organization here follows the one used in both *Science for All Americans* and *Benchmarks for Science Literacy.* Each chapter includes clusters of closely related maps that loosely correspond to the section in the matching Benchmarks chapters. Each map is accompanied by commentary that includes a general discussion of the topic, a brief summary of the content of the map, and remarks on related themes, historical episodes, or topics that have not yet been mapped. The second part of the commentary includes notes that point out interesting or difficult aspects of the map and research relevant to the map. The final chapter includes information on how the idea of strand maps originated and how they were constructed. A reference table shows how each of the benchmarks is distributed throughout the strand maps. (Author/SSD) ENC-018882

Ordering Information
National Science Teachers Association, PO Box 90214, Washington, DC 20090
Email: science.scope@nsta.org
(703) 243-7100 / Fax: (888) 433-0526 / Toll-free: (800) 722-6782
www.nsta.org
$49.95 per book (spiral-bound)

Designs for Science Literacy

Grades K-12
2000

Author: American Association for the Advancement of Science, Project 2061

This book extends the goals of Project 2061, with the intent of tackling the fundamental challenge of how to design complete K-12 curricula that result in scientifically literate students. The text considers the application of general design principles to curriculum, envisions how curriculum can be designed using various high-quality instructional blocks, and suggests steps for improving an existing curricular framework. A sample chapter, Building Professional Clarity, discusses the need for faculty science literacy. A strand map explains the development of students' science thinking, and suggestions are given for ways of aligning instructional topics with benchmarks. Tips are included for understanding student learning goals, becoming familiar with research on learning, and improving assessment practices. A supplementary CD-ROM is also provided that contains a complete, searchable copy of the book, a compilation of resources for additional information, and databases for customizing curriculum plans. (Author/JG) ENC-018937

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$49.95 per book (paperback) with hybrid CD-ROM

Principles and Standards for School Mathematics: E-standards

Grade PreK and up
2000
Author: National Council of Teachers of Mathematics

On this CD-ROM, users can access the full text of *Principles and Standards of School Mathematics,* along with enhanced navigation and interactive features. Also on the disc are NCTM's three previous standards documents. *PSSM* is intended to be a resource and guide for all who make decisions that affect students' mathematics education. It presents a vision of school mathematics based on the belief that all students should learn important mathematics concepts and processes with understanding. *PSSM* builds on NCTM's previous standards documents and reflects input from many groups and individuals in its development. Its six principles for school mathematics address overarching themes: equity, curriculum, teaching, learning, assessment, and technology. These principles describe the particular features of a high-quality mathematics education and are offered as guides for decision making. Each principle is discussed in detail in terms of the vision for school mathematics developed in *PSSM.* Also presented are 10 standards for school mathematics that describe what mathematics instruction should enable students to know and do as they progress through the grades. The five content standards are number and operations, algebra, geometry, measurement, and data analysis and probability. In actual classroom practice, the areas described by these content standards overlap and are integrated. The five process standards are problem solving, reasoning and proof, communication, connections, and representation. Each standard includes goals that apply across all grades; the content standards offer an additional set of expectations specific to each grade band. The presentation is highlighted with examples of student work and examples from the classroom told in the words of teachers. The Table of Standards and Expectations in the appendix presents a concise summary of expectations related to each content standard arranged by grade band. Also found is a preK to 12 overview summary of expectations for the process standards. References are included in *PSSM.* (Author/JRS) ENC-018289

The standards are also available online at http://standards.nctm.org/ (see ENC-17737 for more information).

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National Council of Teachers of Mathematics, Inc., 1906 Association Drive, Reston, VA 20191
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www.nctm.org
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Learning Mathematics for a New Century

Series: NCTM Yearbook
Grades K-12
2000
Author: Frances R. Curcio, Maurice Burke

Developed by the National Council of Teachers of Mathematics as a resource for mathematics educators, this yearbook contains papers from a wide variety of authors that address the challenge of teaching mathematics in a rapidly changing world. The four major sections focus on numeracy and standards, technology, curriculum, and the classroom learning environment. Papers explore topics related to teacher preparation, technological change, functional mathematics as a curriculum, and improved, equitable learning environments. For example, one article describes building a discourse community in a mathematics classroom by using a three-pronged instructional model to explain, build, and go beyond. With this model, students engage in constructive dialogue on mathematical issues while learning to value the contributions of each class member. Another article presents a comprehensive set of pedagogical principles intended to develop classroom equity while encouraging high achievement of all students. The yearbook's conclusion challenges researchers and practitioners to address the significant and unsolved problems related to equity, student understanding, curriculum, assessment, and professional practice that were handed down from the twentieth century. References are included with each paper. (Author/JRS) ENC-019284

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Education in a New Era

Series: ASCD Yearbook
Grades K-12
2000
Author: Ronald S Brandt

The collection of articles in this book analyze the educational advances of the last century, summarize current research across the field, and make predictions about what may or should happen to education during the coming years. Topics include the history of American education, the social and political origins of the quest for educational equality, and a summary of the evolving science of learning. The chapter covering the latter topic includes a discussion of behaviorism, cognitive science, constructivism, and modern brain research. There are also examinations of specific teaching strategies that have emerged from educational theory and speculations on how these techniques might be developed in response to future research and advances in classroom technology. Each chapter showcases the unique stylistic approach of its author and includes a list of references. Some chapters concentrate on theoretical considerations supported by a review of important primary research articles, while other chapters are illustrated with accounts of real-world teaching scenarios. The variety of ideas expressed and the diversity of visions for the future create a wide-ranging montage that touches on most current educational issues and illuminates multiple perspectives on how they might unfold for both teachers and students in the years ahead. Information on the research interests, credentials, and current location of all the authors is also included. (Author/RJD) ENC-017545

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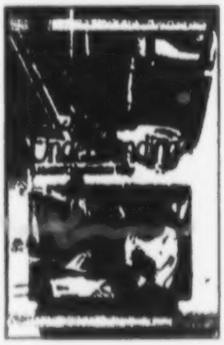
Assessing Science Understanding: A Human Constructivist View

Series: Educational Psychology
Grades K-12
2000
Author: Audrey B Champagne et al



Teachers can find in this book a theoretical, empirical, and practical guide for using alternative techniques to assess their students' science understanding. Each chapter is written by an authority in the field of science education. A recurring theme is the idea that success in creating, learning, and using knowledge is not well reflected by traditional assessment practices that rely on single, quantitative measures of subject matter attainment. The assessment techniques advocated in the book are grounded in two principal assumptions: understanding is not meaningfully revealed by normalized comparisons among students; and conceptual change is not adequately represented by a single standardized alphanumeric score. The book discusses techniques that range from interviews and image-based assessment to portfolios and concept maps. The book also addresses issues related to national and international testing programs, the psychometrics of performance measures, and the limitations of pencil and paper examinations. (Author/JR) ENC-018695

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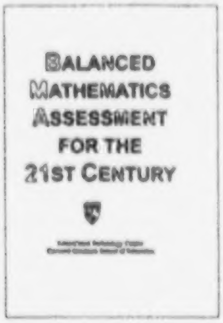
$69.95 per book (hardbound)

Balanced Mathematics Assessment for the 21st Century

Grades K-12
Series: Balanced Assessment Program
1995
Author: Educational Technology Center, Harvard Graduate School of Education

Designed for all grade levels, this collection of more than 300 classroom-ready activities was developed to provide thought-provoking and mathematically rich tasks that reflect reform



values in mathematics education. The tasks have been assembled to provide a balance with respect to the content areas of number and quantity, shape and space, function and pattern, chance and data, and arrangement. They are also designed to provide a balance of the mathematical actions involved in completing the activities: modeling and formulating, transforming and manipulating, inferring and drawing conclusions, and communicating. The accompanying CD-ROM contains printable versions of all activities, along with solution discussions, scoring rubrics, and software and spreadsheet data for use with the technology-based activities. In the elementary activity Broken Calculators, for example, students are asked how they would show the year in which they were born on their calculator if the only keys working on their calculators were the 0, the 1, the +, and the - keys. The activity contains another problem asking students to find a way to add on a calculator that doesn't involve using the + key. The CD-ROM contains a report on the authors' approach to assessment as well as Spanish language versions of all the activities. (Author/MM)
ENC-019277

Ordering Information
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Email: joan_kenney@harvard.edu
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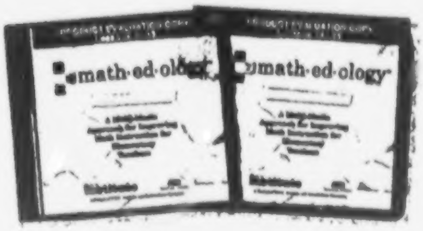
balancedassessment.gse.harvard.edu
$40.00 per hybrid CD-ROM/with book

Math-Ed-Ology: A Multimedia Approach for Improving Math Instruction for Elementary Teachers

Grades K-5
1999



This set of two CD-ROMs provides an in-depth look into classrooms where teachers model the application of many of the NCTM Standards, as well as bilingual and ESL teaching strategies. Each of the 25 lessons includes video episodes from the classroom, complete lesson plans, and expert commentary for mathematicians, math educators, and bilingual and ESL educators. A major goal is to help teachers extend their ability to think critically about teaching, interpret classroom situations, and develop suggestions for improving teaching. Lessons include domino shapes and numbers for kindergarten, multiplication patterns for grades 3-5, and multiples with large numbers for grades 4-5. In a sample lesson, Patterns from Doubling, the teacher offers to pay students for all the hard work they have been doing in her class. The teacher presents two pay options to the class. The first is to pay a student $5 a day for 20 days. The second is to pay a student one penny on the first day and double the amount of the previous day on each consecutive day for 20 days. Students, working in small groups, decide which plan seems more profitable and then determine how much the chosen plan will pay. Finally, they try to justify their decision by doing the math for both plans and comparing the totals. Student groups create math posters that show comparisons of the two plans. An important outcome is that students will see and be able to state a relationship between the daily payments and the total received if the penny option is selected. (Author/JRS)
ENC-018835

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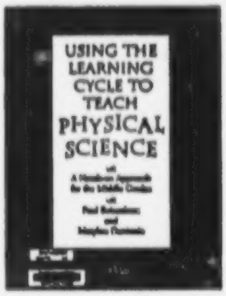
$99.00 per CD-ROM package (2 hybrid CDs)
Note: Site license and volume discounts available.

Using the Learning Cycle to Teach Physical Science: A Hands-On Approach for the Middle Grades

Grades 5-8
1996
Author: Marylou Dantonio, Paul C. Beisenherz



Using a learning cycle strategy, this book presents seven basic physical science concepts that are common to most middle school science curricula. The learning cycle strategy enables students to construct discrete science concepts. It includes an exploration phase, in which students are exposed to hands-on activities; an introduction phase, in which the concept is formally introduced; and an application phase, in which the concept is reinforced and expanded through additional experiences. All phases use teacher questions to guide the learning experience. Section one discusses how to integrate the science processes into a learning cycle through effective questions and questioning sequences. This section also develops a rationale for the learning cycle as an effective way to teach science concepts. Section two includes six learning cycles on six physical science concepts: Bernoulli's principle, acids and bases, properties of gases, expansion and contraction of gases, circuits, and density. Each learning cycle focuses on a single concept and includes a number of sequenced, hands-on activities. In addition, each learning cycle begins with a brief introduction to the content topic, a discussion of the strategy developed for that content topic, and a list of related reference materials. In a sample learning cycle on density, students observe properties of food coloring, tap water, and salt water, then explore the concepts that salt water is heavier than tap water and that salt water can be made heavier by increasing the concentration of salt. After being introduced to these concepts, students calculate the density of various objects such as rubber stoppers, eggs, and soda cans to apply the concept to new situation. The third section of the book contains randomly sequenced activities related to the concept of surface tension, designed to provide

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teachers with an opportunity to develop their own learning cycle sequence. (Author/YK) ENC-015447

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www.heinemann.com
$26.50 per book (paperback)

Algebraic Thinking Math Project (ATMP), Grades 3-8

Series: PBS MATHLINE
Grades 3-8
1999
Author: producers Bob Morris, Jill Peters, Mary Drayne, Sandra Sheppard, Suzanne Rose
Publisher: Thirteen/WNET New York, PBS

Part of the PBS MATHLINE series, this set of videos features classroom lessons designed to foster the development of algebraic thinking in students. The set is based on the NCTM Algebra Standard that stresses the importance of beginning experiences in algebraic reasoning at the elementary level and building through middle school. These video lessons model the teaching of algebraic concepts, show how these concepts can be developed across the grades, and provide a forum for discussing issues relating to algebraic thinking in grades 3-8. In a sample lesson, the teacher presents a problem from an eighth grade international mathematics test. Students are asked to look for patterns in the number of small similar triangles that are used to form a sequence of larger triangles. The goal is to formulate a general rule and express the rule using a variable. Working in groups, students exchange ideas, organize information about the problem, and present their explanations and solutions to the class. Footage from individual student assessment interviews shows a variety of approaches to the problem and the range of student algebraic thinking. The teacher extends the lesson with another problem that offers additional challenges to the successful students and gives less successful students additional experience with analyzing patterns. This second problem reinforces the link between real-world situations, graphic representations, and symbolic algebra. An accompanying lesson guide provides detailed procedures, mathematical background, pedagogical ideas, and student worksheets for replicating each video lesson. (Author/JRS) ENC-019296

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Illuminations: Principles and Standards for School Mathematics

http://illuminations.nctm.org
Grades PreK-12
2000
Author: Sam Weebben
Publisher: National Council of Teachers of Mathematics

Created by the National Council of Teachers of Mathematics, this web site provides online information and activities to support and demonstrate how the new mathematics standards, *Principles and Standards for School Mathematics (PSSM)*, can be applied in the classroom. The site is divided into four grade bands—preK to grade 2, grades 3 to 5, grades 6 to 8, and grades 9 to 12—and an additional area, Across the Grades. A sample section called i-Math features ready-to-use interactive mathematical investigations for students; these include teacher notes, discussion questions, and connections to pages of the *PSSM*. In an activity for preK to grade 2, students work with an online LOGO application to find the shortest path for a turtle to walk to a pond. In another activity, designed for grades 9-12, multiple applets are presented to allow for experimentation with linear regression, the line of best fit, and the meaning of the correlation coefficient. Other sections of the site offer video vignettes of classroom activities to promote discussion; Internet resources with mathematics background information and support for the implementation of the *PSSM*; lesson plans for each grade band; and a searchable interactive version of the updated NCTM standards. (Author/JRS) ENC-016955

Selecting Instructional Materials: A Guide for K-12 Science

Grades K-12
1999
Author: Jan Tuomi, Maxine Singer

This report includes information on a tested procedure for evaluating and selecting K-12 science instructional materials that is consistent with state and national standards. The guide is designed to assist local school districts in training evaluators and carrying out an effective review and selection process. It discusses the various circumstances in which curricular materials are selected by comparing the selection participants in adoption states, such as California and Texas, to those in states where there is more local control. The guide outlines national efforts to evaluate instructional materials, such as Project 2061, the National Science Resources Center, and the Center for Science, Mathematics, and Engineering Education. In the introduction, the book states that reviewers of curriculum will need to be versed in the standards, to have experience teaching the grade levels for which the materials are being considered, and to have the knowledge and understanding of science as described by the national standards. The five-step review and selection process presumes that the model can be applied to either a comprehensive science program or a small part of a program, that the review and curriculum framework will be standards-based, and that at least two people will review all material. Forms for the review and selection of materials are provided in the book. The book gives a web address so that readers can copy and customize the forms. (Author/JR) ENC-017315

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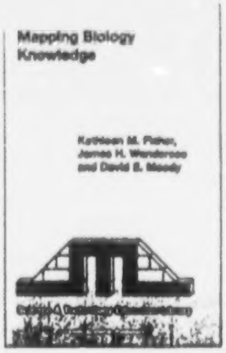
$18.95 per report (paperback)

Mapping Biology Knowledge

Series: Science & Technology Education Library
Grades 8-12
2000
Author: David E. Moody, James H Wandersee, Kathleen M Fisher


Mapping Biology Knowledge
Kathleen M. Fisher, James H. Wandersee and David E. Moody

Written for biology teachers, this book addresses two key topics: meaningful learning and the role of knowledge mapping in promoting this learning. Chapters provide an overview of knowledge mapping, its use in the classroom, and the underlying research on semantic networking that supports this process. Visual representations with descriptions are presented throughout the book and include schematic diagrams, concept maps, and concept circles. The use of SemNet software, a mapping tool, is also discussed and is accompanied by illustrative pictures. The nature of learning is highlighted by an exploration into the misconceptions that students have about biological concepts, the way in which knowledge is encoded into the brain, and the need for language clarity. In a sample chapter, Knowing Biology, the author stresses the importance of optimizing students' knowledge structures by decreasing the overload of complex details that will rarely be used. This calls for a systems approach, such as that devised by J. G. Miller, where information can be oriented within personally experienced situations. (Author/JG)
ENC-019163

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Crocodile Chemistry

Grades 9-12
Author: Crocodile Clips Ltd., distributed by Sargent Welch
1999

High school students can use this CD-ROM to simulate chemistry experiments onscreen. Chemicals and equipment can be selected to investigate different reactions. The program has menus with reactants that allow the user to choose the strength, form, and amount of the chemicals to be delivered. For example, the program offers metals in rod, liquid, and fine or coarse powder forms. The users can also select the number of grams of powder they want. The program's glassware choices range from beakers and test tubes to delivery tubes and burettes. Students can heat chemicals with virtual Bunsen burners and add water from a simulated faucet. As they run their onscreen experiments, the program will simultaneously present the data on graphs, which have been designed by the students. Simulations are provided that introduce the features of the program. (Author/JR)
ENC-018551

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Note: Multi-user pricing is available; contact vendor for further information.

A Private Universe Project in Mathematics: A Professional Development Workshop for K-12 Mathematics Teachers

Series: Private Universe Project in Mathematics
Grades K-12
2000
Author: Paul Stern, director

This seven-session video workshop provides teachers, administrators, and others with a forum in which to explore issues related to teaching and learning mathematics. Each session features a 60-minute video that shows preK-12 students and teachers engaged in mathematical problem solving. The sessions explore the belief that students develop mathematics knowledge and competence most effectively when they work on challenging problems, discuss strategies, and regularly present justifications for their solutions. The videos document the mathematics thinking of a focus group of students as they progress from grades 1 to 12. Footage shows the students in small-group problem-solving sessions, whole-class discussions, and individual task-based interviews. Also shown are teachers engaged in staff development, often dealing with the same mathematics questions that engaged the students. Workshop participants solve the mathematics problems presented in the videos and explore questions based on the shared experience of watching the videotapes. Key questions focus on teaching and learning mathematics, communicating mathematical ideas, and nurturing conditions that foster mathematics development. The goal is for participants to learn to recognize what is mathematical in students' activities. In a sample workshop session, teachers in a summer professional development course and the focus group of students grapple with the same combinations problem: How many different towers four blocks high can be made with two different colored blocks? The viewer sees both the students and the teachers develop strategies and apply two kinds of proof: proof by cases and proof by induction. (Author/JRS)
ENC-019292

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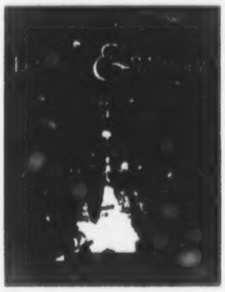
$24.95 for any of the six 90-minute programs on a single video

Learning and Memory: The Brain in Action

Grade K and up
1999
Author: Marilee Sprenger
Association for Supervision and Curriculum Development (ASCD)



Drawing from current research, this book describes the function of brain cells, the effects of brain chemicals, and the anatomy of the brain. The author uses her own classroom experience to explain how brain-compatible methods of teaching can positively influence classroom learning and dynamics. The book gives an illustrated description of brain areas, functions, and memory storage systems with specific examples of how brain research can be applied to the learning environment and assessment practices. The author examines teaching strategies based on the most-used memory lane, semantic memory, and on the less-used routes for episodic, procedural, automatic, and emotional memory. Specific classroom strategies are suggested for building memory in students, such as reducing the amount of stress in the classroom and using graphic organizers such as time lines and power pictures or mind maps. The section Accessing Multiple Memory Lanes provides an example of how teaching can address multiple avenues to memory. In this unit, students read the novel The Rifle and discuss how they feel about guns and gun control, thus beginning to create emotional memories. Drive-by shootings, hijackings, and school shootings are also discussed. As the unit progresses, students bring in articles about guns, the teacher regularly plays a popular recording from the 70's that deals with the law, and groups of students act out segments of the novel. The class debates the statements: guns kill people and people kill people. The activities in the unit employ the development of the episodic, procedural, and emotional lanes of memory. A glossary of brain related terms and a bibliography are included. (Author/JRS) ENC-018488

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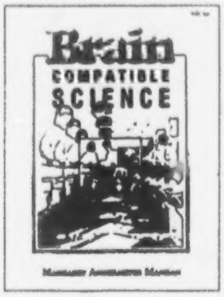
Brain-Compatible Science

Grade K and up
1998
Author: Margaret Angermeyer Mangan



This book articulates the connections between chaos theory and brain-based curriculum design. The author discusses the need for science educators to break away from the standard, rigid, Newtonian model of thinking and begin to see classrooms as more process-oriented places.The first section of the book explains the basic principles of chaos theory. This section deals with issues such as constructing new meaning from old ideas, looking for similarities among systems, and believing in the power of guiding principles and values. A lesson plan for a class activity and a list of applicable web sites are provided at the end of each chapter. The second section of the book describes how teachers can begin to look at science pedagogy in a new way. One of the chapters discusses the inherent nature of organisms to organize themselves and their activities. Background information is cited from such researchers as Weiner, Lovelock, and Wheatley. This is followed by a description of how chaos theory, brain compatibility, and science instruction can be used together to explain self organizing principles. The ending activity, designed for grades 3-6, asks students to investigate the importance of food webs through the act of translating the poem Jabberwocky by Lewis Carroll. Students replace nonsense words with real words, create Jabberwocky food chains, and use a ball of string to create a visual food web. Web sites covering such themes as the Global Thinking Project and *Alice in Wonderland* are suggested to follow the activity. The final section summarizes the contents covered in the book and provides a glossary of terms. (Author/JG) ENC-018672

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Skylight Training and Publishing, 2626 South Clearbrook Drive, Arlington Heights, IL 6005
Email: info@irishylight.com
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www.skylightedu.com
$38.95 per book (paperback)

BrainConnection.com

www.brainconnection.com
Grades PreK-12
1999
Author: Scientific Learning Corporation

The articles, brain teasers, and professional development information at this web site concern the relationship between the brain and learning. Illustrations and animations show how the sensory systems and the brain work together to collect and process information. Users can select categories, such as auditory, education, and memory, from a topics menu to find specific information. Visitors can play brain teaser games that test their reaction times, short-term memory, and reading skills. The site describes online courses about how the brain develops and is involved in learning language and reading. Featured articles are hyperlinked from an alphabetical list on the site. Announcements are posted for conferences related to brain research and best instructional practices. (Author/JR) ENC-018627

How People Learn: Brain, Mind, Experience, and School

Grade PreK and up
2000
Author: Ann L Brown, James W. Pellegrino, John D. Bransford, M. Suzanne Donovan, Rodney R. Cocking

Educators interested in discovering how people learn can use this book as a starting point. The book is an expansion of two previous reports published by the National Research Council that were based on studies of the science of learning and actual practice in the classroom. The first two parts of the book focus on three organizing decisions: research on human learning —including new developments in neuroscience; learning research that has implications for the design of formal instructional environments; and research that helps explore the possibility of helping all individuals achieve their fullest potential. Key findings featured in this section include the need for learning facts in a conceptual framework that is organized in a way that facilitates retrieval and application. A section on teachers and teaching presents findings on the need for learner-centered schools and classrooms and the need to give attention to content, conceptual understanding, and mastery. The influence of community-centered schools is stressed, including connections to the outside world that support core learning values. The author asserts that formative assessment should be found throughout learning to provide the best opportunity for feedback to both teachers and students. Finally, the book proposes 33 different directions for future research in learning and schools. (Author/SSD) ENC-018331

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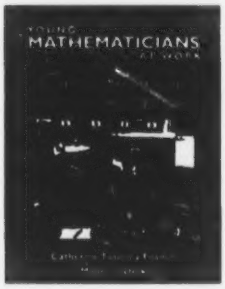
National Academy Press, Lockbox 285, 2101 Constitution Avenue NW, Washington, DC 20055
(202) 334-3313 / Fax: (202) 334-2451 / Toll-free: (888) 624-8373
www.nap.edu
$24.95 per book (paperback)

Young Mathematicians at Work: Constructing Number Sense, Addition, and Subtraction

Grades PreK-3
2001
Author: Catherine Twomey Fosnot, Maarten Dolk



This professional development book explores and links ideas about mathematics education found in the United States and in the Netherlands. It describes strategies for constructing number sense, learning basic facts, exploring place value, and using modeling to make sense of the world. The book offers stories from classrooms and samples of student work to illustrate teaching that promotes investigations and inquiry with real-world contexts. The authors believe that constructivist-based professional development in the United States helps teachers see the big ideas, but find that little attention is paid to didactics—a scientific theory of instruction relating to developing, stretching, and supporting mathematical learning over time. The book draws from the work of Dutch mathematician Hans Freudenthal, who believed that people learn mathematics by actively investigating realistic problems and claimed that mathematics was actually an activity of mathematizing the world—of modeling, of schematizing, of structuring one's world mathematically. Included are sample minilessons on the use of the open number line model as a way to support the development of efficient computation. References are included. (Author/JRS) ENC-019274

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Heinemann Educational Books, Inc., 88 Post Road West, PO Box 5007, Westport, CT 06881
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(603) 431-7894 / Fax: (203) 750-9790 / Toll-free: (800) 793-2154
www.heinemann.com
$22.00 per book (paperback)

Mathematical Modeling in the Environment

Series: Classroom Resource Materials
Grade 9 and up
1998
Author: Charles R. Hadlock

Readers of this resource book are introduced to some of the critical environmental issues of the day and to the vital role mathematical modeling plays in investigating these issues. The environmental issues addressed include ground water contamination, air pollution, and hazardous material emergencies. The author is an applied mathematician with consulting experience on major environmental issues such as Three Mile Island, Love Canal, and Bhopal. He presents the issues in a real-world, interdisciplinary context and invites readers to investigate environmental concerns in their own communities. The first part of the book develops elementary modeling of these phenomena, including algebraic equations for ground water. Slightly more complex equations, best implemented on a spread sheet, are given for air pollution. A fully computerized modeling package is included for hazardous materials incident analysis. The second part of the book returns to the same three subjects, but with a higher level of mathematical sophistication. Both parts include mathematical exercises intended for class discussion. An accompanying diskette contains a spreadsheet program and a program for evaluating the consequences of various hazardous materials scenarios, including the physical extent of flammable and toxic vapor clouds. The accompanying solutions manual includes advice for teachers who lack previous environmental experience, along with complete solutions for all exercises. (Author/JRS) ENC-017240

Ordering Information
Mathematical Association of America, PO Box 91112, Washington, DC 20090
(301) 617-7800 / Fax: (301) 206-9789 / Toll-free: (800) 331-1622
www.maa.org
$18.95per book (paperback); MAA members price $14.95
$55.00 per book with 1 computer disk (DOS); MAA member price $43.95

Action, Talk and Text: Learning and Teaching Through Inquiry

Series: Practitioner Inquiry Series
Grades K-12
2001
Author: Gordon Wells, Greta Davis, Karen Hume, Maria Kowal, Mary Ann Van Tassell, Monica McGlynn-Stewart, Zoe Donoahue

Created through the Developing Inquiring Communities in Education Project (DICEP), this book addresses the issues of how classrooms can become environments of inquiry and how inquiry can be used to extend and transform individual and collective understandings. This collection of essays describes classroom experiences that demonstrate components of inquiry-based learning. Chapters focus on ways that students construct meaning, the value of class discussions, and how to foster knowledge building. A sample chapter illustrates how a teacher of gifted sixth and seventh graders created a knowledge wall where students could post questions, display research results, and present information to others. Excerpts from in-class discussions and postings follow the progress of students as they move from superficial attempts at learning to more substantive explorations. The authors also note the transformation of the classroom atmosphere as individualistic perspectives gave way to collaborative efforts. The last section of the book provides an argument for the use of inquiry in the classroom and reflects on the DICEP experience. (Author/JG) ENC-018875

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Teachers College Press, Columbia University, PO Box 20, Williston, VT 05495
Email: tcp.orders@aidcvt.com
Fax: (802) 864-7626 / Toll-free: (800) 575-6566
www.teacherscollegepress.com
$24.95 per book (softcover)

Learn and Live

Grades K-12
2000ed
Author: George Lucas Educational Foundation

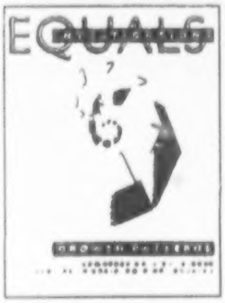
The George Lucas Educational Foundation (GLEF) produced this CD-ROM to address methods of handling issues currently plaguing schools. The program contains an hour long documentary, a 300-page resource book, and a Digital Toolkit that presents portions of the documentary with support materials. Users can also find an annotated list of resources related to emotional intelligence as well as an archive of the *GLEF newsletter, EDUTOPIA*. The documentary, hosted by Robin Williams, features footage of students in school settings as well as the comments of national figures in business and education, such as Bill Gates, Howard Gardner, and General Colin L. Powell. The CD covers topics such as project-based learning, emotional intelligence, school-to-career programs, interdisciplinary curricula, and schools as community learning centers.The program materials suggest that the Digital Toolbox can be used for research on educational themes or for workshops, classes, and conferences in which issues of education reform, effective teaching and learning, or technology integration are being explored. The Digital Toolbox allows the users to watch a digital video clip profiling one of the topics and then link to background information, related web sites, articles from the *Learn and Live* resource book, and a glossary of education terms. For example, the section on project-based learning shows a class working on an entomology unit. Viewers see the students collecting insects, creating multimedia reports, and using two-way fiber optic technology to view their samples through an electron microscope. The program offers discussion questions about the use of technology in the schools and suggests the Bugscope web site as a scanning electron microscope source. An article about peer critique circles is offered as a supplemental reference. (Author/JR) ENC-017693

Ordering Information
The George Lucas Educational Foundation, PO Box 3494, San Rafael, CA 94912
(415) 662-1600 / Fax: (415) 507-0499 / Toll-free: (888) 475-4371
www.glef.org
$6.00 per CD-ROM

New Directions in Curriculum: Mathematical Modeling

Growth Patterns

Series: EQUALS Investigations
Grades 6-9
1994
Author: EQUALS
Publisher: Lawrence Hall of Science, University of California

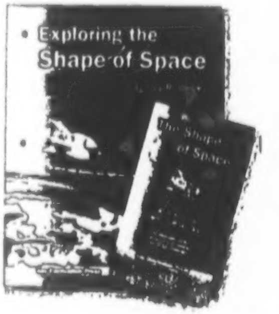


Part of the Work on Investigations Units series, this four- to eight-week unit addresses the topics of linear and exponential growth models. The Investigations Units series is a part of the EQUALS program, a teacher education program designed to help teachers acquire methods and materials to attract minority and female students to mathematics. It supports a problem-solving approach to mathematics, including having students work in groups, use active assessment methods, and incorporate a broad mathematics curriculum in a variety of contexts. Each unit has a range of entry levels that allow students of varying experience to be challenged on an individual level and to fully participate. The units integrate language, writing, and hands-on work in cooperative settings and are designed to be used in bilingual or multilingual settings. Student pages are in English and Spanish. In this unit, students explore the questions of how things grow and how growth can be described and predicted by building mathematical models and investigating real-world phenomena. The unit presents and contrasts the two simplest discrete models of growth: repeated addition and multiplication. (Author/GMM) ENC-008616

Ordering Information
EQUALS Publications, University of California, Berkeley, Lawrence Hall of Science #5200, Berkeley, CA 94720
Email: equals@uclink.berkeley.edu
(510) 642-1910 / Fax: (510) 643-5757 / Toll-free: (800) 897-5036
www.etdc.wednet.edu/equity/organizations/18.html
$21.95 per book
$110.00 per set of 5 books

The Shape of Space

Series: Life by the Numbers
1995
Grades 6-10
Author: Tamara Munzner, director

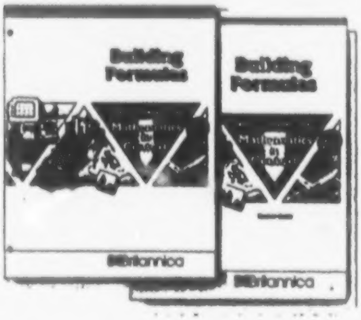


This teaching unit contains nine lessons that introduce students to one-, two-, and three-dimensional geometry through exploration of possible shapes for our three-dimensional universe. Students explore topological models of the universe in an intuitive, hands-on way with paper-and-scissors activities, pencil-and-paper games, two CD-ROM games, and a computer-animated video entitled *The Shape of Space*. The video contains material from the PBS video series Life by the Numbers and an interview with a mathematician. The mathematician uses objects found in nature and computer games to illustrate the mathematical universe. Throughout the unit, geometry interweaves with cosmology, including current research efforts to determine the shape of the real universe. Each lesson contains complete teacher notes, blackline master student activity sheets, homework assignments, and optional transparency masters. Also included with every lesson are a final test, a reproducible glossary, and an answer key. In a sample activity, students explore how a space may be finite or infinite and with or without boundaries. Using worksheets, students consider four pictures of a one-dimensional universe: a line segment with two endpoints, an infinite line, a ray, and the circumference of a circle. They estimate length, color boundary points blue, and use a matrix to categorize the geometric shapes. In a bonus problem, students make a matrix and invent three-dimensional universes for each of the four spots on the matrix. (Author/JRS) ENC-019288

Ordering Information
Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608
Email: orders@keypress.com
Fax: (800) 541-2442 / Toll-free: (800) 995-6284
www.keypress.com
$45.95 per set (includes 1 video, 1 teacher's resource text, activity book, and hybrid CD-ROM)
$29.95 per video
$29.95 per activity book with CD-ROM

Building Formulas

Series: Mathematics in Context
Grades 7, 8
1998
Author: Anton Roodhardt, Beth R. Cole, Gail Burrill, Margaret A. Pligge, Martin van Reeuwijk, Monica Wijers

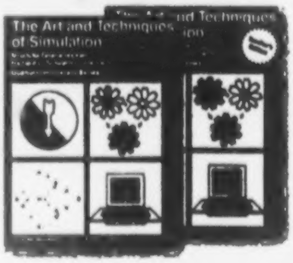


This student text and accompanying teacher guide, part of the Mathematics in Context series, introduce students to different kinds of formulas. The series is a comprehensive curriculum for middle grades developed and field-tested by the National Center for Research in Mathematical Sciences Education at the University of Wisconsin-Madison. In this unit, students describe patterns using both recursive and direct formulas; they also represent patterns through pictures, word descriptions, and tables of values. In a section on area, students investigate squares, square roots, and square numbers through study of the world's largest living organism, a fungus with an area of 154,000 square meters. Surface area, square units, and area formulas are then linked. Other formulas in the unit deal with temperature (Fahrenheit and Celsius), heart rates, staircase design, and ideal body proportions from Egyptian art. The teacher guide includes suggestions for informal assessment and a set of blackline masters containing a letter to families, student activity sheets, and assessment masters. The series is designed to reflect the 1989 NCTM standards. (Author/JRS) ENC-011850

Ordering Information
Encyclopedia Britannica Inc Mathematics in Context, 310 South Michigan Avenue, Chicago, IL 60604
Fax: (312) 347-7966 / Toll-free: (800) 554-9862x7007
www.britannica.com
$5.35 per student book
$21.55 per teacher guide

The Art and Techniques of Simulation

Series: Quantitative Literacy
Grades 8-12
1987
Author: Jim Swift, Mrudulla Gnanadesikan, Richard L Scheaffer



The third of four in the Quantitative Literacy series, this set of textbook and teacher's guide covers the basic concepts of statistics and probability through the use of real data, active experiments, and student participation. The book features 30 applications that require the design and enactment of a simulation, together with questions designed to elicit the main statistical and probabilistic results arising from the simulation. The textbook has a complete step-by-step guide to constructing a simulation model. Fully-worked solutions are given to three problems including: What is the probability that a three-child family will contain exactly one girl? The applications become more conceptually difficult as the student progresses through the book. In the application Family Planning, for example, students are asked to simulate a situation in which the government permits people to continue to have children until they have exactly one son. Students are then asked to answer questions such as: What is the average number of girls per family? The teacher's edition contains quizzes with answers, as well as complete solutions and teaching notes for each application in the textbook. It also contains a statement of principles for the series, including the notion that discussion and evaluation of different approaches should take up a large part of class time and that real data should be used whenever possible in statistics lessons. (Author/MM) ENC-018190

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Dale Seymour Publications, 4350 Equity Drive, PO Box 2649, Columbus, OH 43216
(800) 237-3142 / Fax: (800) 393-3156 / Toll-free: (800) 321-3106
www.pearsonlearning.com
$11.90 per book (paperback)
$16.95 per teacher's edition

Mathematical Modeling: Using Graphs and Matrices

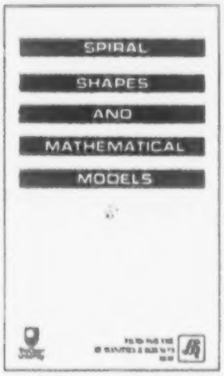
Series: Learning in Motion
Grades 9-12
1997
Author: Learning in Motion

The interactive activities in this software require students to use matrices and graphs to model situations such as airline or car routes, cooperation and competition, and population growth and decline. With this software, students can manipulate data and explore the connection between the visual representation (graph) and numerical representations (table and matrix). The accompanying teacher's guide is divided into two sections. The first section features background information on discrete mathematics topics such as similarity of graphs, map coloring, and Markov processes. The guide also gives step-by-step illustrated directions for using the drawing and calculating features of the software. In the second section, there are reproducible student worksheets with teacher notes stating the goals and answers for each worksheet activity. In a sample worksheet activity, students use the software to simulate traffic flow during an evening rush hour. Data are shown on the network or graph and in a matrix that indicate the number of cars passing through each intersection in fifteen-minute intervals. Students develop strategies and modify the traffic flow with the goal of not overloading the intersections. Students answer a series of questions as they investigate their modification. They compute the traffic distribution using the software to do matrix multiplications and then write an explanation to justify their modification of the traffic pattern. (Author/JRS) ENC-018932

Ordering Information
Learning In Motion, 500 Seabright Avenue, Suite 105, Santa Cruz, CA 95062
Email: helpdesk@learn.motion.com
(831) 457-5600 / Fax: (831) 459-6876 / Toll-free: (800) 560-5670
www.learn.motion.com
$59.00 per software package (Windows)

Spiral Shapes and Mathematical Models

Series: Seeing Through Mathematics
Grades 9-12
1997
Author: Pip Sergey



This video, part of the Seeing Through Mathematics series, examines the fundamental features of spirals and describes how they can be modeled mathematically. Other videos in the series highlight the mathematics of polling, the medical use of statistics, and the mathematics found in architecture. In this video, both two- and three-dimensional spirals are examined with examples such as an amusement park slide and a DNA double helix. Spiral features that are used to differentiate spiral types include angle, radius, pitch, and rotation. The sine wave is used to model the differences between spirals with a constant distance between the rings and spirals with a decreasing distance between rings. The program describes the flight of a moth as it approaches a light source and the development of the chambers in the shell of a Nautilus as examples of the ways spirals appear in nature. (Author/JRS) ENC-018775

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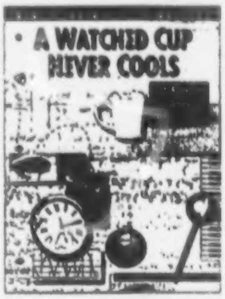
Films for the Humanities & Sciences, PO Box 2053, Princeton, NJ 08543
(415) 328-3825x239 / Fax: (609) 275-3767 / Toll-free: (800) 257-5126
www.films.com
$129.00 per video

A Watched Cup Never Cools:
Lab Activities for Calculus and Precalculus

Grades 10-12
1999
Author: Ellen Kamischke



Calculus teachers can use the hands-on activities in this book to give students open-ended experiments designed to help them develop conceptual understanding. The book consists of 19 blackline master activities and 11 writing assignments in which students investigate and write about such topics as continuity, critical points, and limits. The activities emphasize the use of technology in the form of graphing calculators and dynamic geometry software. Each activity comes in a student version and a teacher version. The student version is a reproducible set of questions to be answered. The teacher version lists prerequisite knowledge, equipment needed, and complete solutions and comments for each question in the student version. Included with each writing activity are samples of student responses taken from the author's classroom. In a sample activity, A River Runs Through It, students determine the volume of a lake and the amount of time needed to reduce the concentration of a pollutant by half its original value. Students use the map provided to determine the volume of the lake and develop an exponential equation to calculate the time taken to halve the concentration of the pollutant. (Author/MM) ENC-019226

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www.keypress.com
$19.95 per activity book (paperback)

New Directions in Curriculum: Data Analysis

Counting Ourselves and Others: Exploring Data

Series: Investigations in Number, Data, and Space
Grade K
1998

Part of the Investigations in Number, Data, and Space series, this teacher's resource book focuses on taking surveys and representing results as students engage in counting, comparing, sorting and classifying, and describing data. The series provides a complete K-5 mathematics curriculum that offers students meaningful mathematical problems emphasizing depth in mathematical thinking rather than superficial exposure to a series of fragmented topics. The Investigations curriculum is presented through a series of teacher books, one for each unit of study. Reproducible resources for students are provided, but the curriculum does not include student books. Students work actively with objects and experiences in their own environment and with a variety of manipulative materials and technology, rather than with workbooks and worksheets filled with problems. This book contains four Investigations, each of which includes four to seven sessions. Activities include pair and small-group work, individual tasks, and whole-class discussions. A sample investigation, How Many Are We?, relates counting to the quantity of items in a group, explores one-to-one correspondence, and looks at different representations of the same data set. In the first session, students count the number of people in the class. Each student then creates her own representation of the count with cubes, buttons, counters, or art materials. In later sessions, students investigate the number of noses and the number of eyes in the classroom and make a class eye chart, with each student illustrating an index card with a drawing of her eyes using color and shape. An optional homework assignment is suggested and follow-up activities (Extensions) appear at the end of each activity. Embedded assessment activities are recommended throughout each investigation. These assessments may involve writing and reflecting, a brief interaction between student and teacher, or the creation and explanation of a product. (Author/CMS/KFR/JRS) ENC-012619

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Scott Foresman Addison Wesley, PO Box 2649, 4350 Equity Drive, Columbus, OH 43216
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www.scottforesman.com
$26.51 per book (paperback)

Teach-Stat Activities: Statistical Investigations for Grades 3 Through 6

Series: Teach-Stat
Grades 3-6
1997
Author: Joan Gideon

The materials in this teacher resource book, part of the Teach-Stat series, are for conducting statistical investigations on topics that include discovering preferences in bubble gum, finding how many drops of water will fit on a penny, and exploring which pizza is best. The series offers student activities for grades 1-6 and professional development resources, including materials for conducting an elementary school teachers' workshop to implement the teaching of statistics. The activity books apply a four-stage model for statistical investigation that is intended to give structure and direction to the reasoning used in statistical problem solving. In this model, students identify and pose a specific question, collect the data, organize and display the data, and use the results from analyses to make decisions about the original question. Each activity lists the mathematical focus and leads students through the four-step process. In a sample activity, students gather and represent data about inherited traits, such as the ability to roll the tongue. In the first activity, students gather data about 100 students to create a model of percent that is easy to interpret. Students graph the data and answer the question: What percentage of students can roll their tongue? In the second activity, they gather data to answer the question: Are the parents and siblings of tongue rollers also tongue rollers? Extension activities and blackline masters are included for all activities. (Author/JRS) ENC-016409

Also available from this series is *Teach-Stat Activities: Statistical Investigations for Grades 1 Through 3* (ENC-013831), which contains 15 classroom-tested activities. The activities in this book are organized into three sections: sorting and counting to organize information; creating and organizing data; and collecting and using data about student opinions.

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www.pearsonlearning.com
$16.95 per activity book (paperback)

Data: Chances Are

Series: Math Vantage 1995
Grades 6-9
1995
Author: Math Vantage Project

The fourth video in a four-video unit, this program targets students' ability to make predictions and decisions based on data analysis and knowledge of probability. It is part of the Math Vantage series, which is designed to motivate pre-algebra students with high-energy footage of real-world situations illustrating key mathematical concepts and applications. This video defines probability and poses a series of questions about the chances for different events to occur. The program illustrates the number of possible choices for buying a car with a variety of options, as well as the number of possible outfits from a combination of shirt, pants, and shoes. In each case, the number of choices is used to create a probability fraction. Permutations are shown with phone numbers and license plates. Combinations are demonstrated by selecting two girls from a group of four. The airline industry provides the context for predictions based on experimental probability rather than theoretical probability. Compound events are illustrated with the probabilities of a ball player getting a single hit and stealing a base. Also available for this unit is a teacher's resource book with lesson plans, assessment ideas, and student worksheets. (Author/JRS) ENC-014558

Ordering Information
Great Plains National, PO Box 80669, Lincoln, NE 68501
Email: gpn@unl.edu
(402) 472-2007 / Fax: (800) 306-2330 / Toll-free: (800) 228-4630
gpn.unl.edu
$39.00 per video (Unit 3, Program 15)
$145.00 per Unit 3 Data analysis package (includes Programs 12, 13, 14, and 15 and teacher's guide.)
$5.00 per Unit 3 teacher's guide

Samples and Populations: Data and Statistics

Series: Connected Mathematics
Grade 8
1998

In this student text and accompanying teacher's guide, part of the Connected Mathematics curriculum series, students review statistics concepts introduced in previous grades. This classroom-tested series, designed for grades 6-8, aims to develop students' mathematical knowledge and understanding through connections between mathematics and other school subjects as well as to the world outside the school. Curriculum at each grade level consists of eight units organized around a series

of investigations that emphasize a major concept or cluster of concepts. This unit begins with a problem scenario: The homecoming committee wants to estimate how many students will attend the homecoming dance, but they don't want to ask every student in the school. How could they select a sample of students to survey? How could they use the results of their survey to predict the number of students who will attend? Through four investigations, students analyze data collection and survey strategies, explore methods of sampling, and distinguish between a sample and a population. In investigation two, for example, students consider the implications of making estimates about the entire U. S. population based on a telephone survey involving a few thousand people. The teacher's guide describes mathematical goals for the unit and materials needed. It also correlates applications-connections-extensions (ACE) problems for homework assignments and a summary of mathematical concepts covered in each investigation. The guide also offers a teaching timeline, suggests assessment ideas, and provides blackline masters. Overall, the series focuses on the strands of number, geometry and measurement, algebra, and statistics and probability. (Author/LDR) ENC-010727

Ordering Information:
Prentice Hall School Division, PO Box 11071, Des Moines, IA 50336
(800) 848-9500 / Fax: (877) 260-2530
www.phschool.com
$18.97 per teacher's guide
$5.47 per student text

The Titanic: What Can Numbers Tell Us of Her Fatal Voyage?

asteria.ednet.fsu.edu/~edtech/webquest/titanic.html
Grades 9-12
1998
Author: Barbara McManus, Todd Atkins

At this web site, a webquest allows high school students to do statistical research using links to a database of the Titanic's crew members and passengers. In approximately three class periods, pairs of students research the data, construct spreadsheet tables, and make appropriate graphs to support specific statistical conclusions or to illustrate a topic of importance to them, such as the percentage of survivors by class or gender. Links are provided to sites with background information on the Titanic disaster, so that the students realize that the statistical numbers represent real people. A scoring rubric is included. (Author/JAR) ENC-016342

Seeing Statistics

www.seeingstatistics.com
Grade 10 and up
2000
Publisher: Duxbury

The Duxbury Press maintains this web site to help students of statistics learn the dynamic, visual nature of statistical concepts using interactive methods. The site uses more than 150 Java applets and text to create a web book that is a first course in statistics. The topics include measures of central tendency, measures of spread, the normal distribution, hypothesis testing, and linear regression. The site is accompanied by a user's guide in book form that provides users with a password to gain access to the site. Each chapter begins with an introduction and a section called Why Am I Learning This? On each page there are links to applications of the topic in other subject areas, and there is also a help button. In most cases, students can enter their own data for use in the applet. The guidebook also provides an overview of the web book, a detailed tour of one chapter, a comprehensive illustrated list of the applets, and a brief discussion of examples in psychology and other subjects. In addition, the guidebook includes a guide to statistics software, a glossary of statistical terms, and a list of references. (Author/MM) ENC-019487

New Directions in Curriculum: Chaos and Fractals

The Future of Mathematics: Ferns & Galaxies

Series: Mathematics: What's the Big Idea?
Grades K-8
1997
Author: Alain Jehlen, Carol Jackson

The eighth in the Mathematics: What's the Big Idea series, this professional development video addreses impact of new technologies on what and how mathematics can be taught. The series presents eight programs in a workshop format to help teachers learn mathematics in new and exciting ways, suggests how to teach mathematics in these ways, and shows classrooms that are changing. The videos include guest teachers engaging in group discussion and activities, discussion questions for the viewer, and suggested classroom activities for students. This video illustrates how discrete mathematics topics, such as recursion and iteration, are becoming accessible to students at a younger age. Fractals and chaos theory are introduced as a new branch of mathematics that is accessible to students because of the power of the computer. Three different approaches to the famous fractal, the Sierpinski Triangle, are developed. The program discusses multiple representations of fractals, including fractals on paper, on the computer monitor, and in nature. The guest teachers discuss informal ways to introduce recursion and iteration to students through physical models, such as a set of nested dolls, and through music, as in a musical fairy tale that is recursive in nature. A classroom clip shows elementary students using recursion to find the number of Valentines needed for class distribution. A guide for the series contains outlines of the themes, activities, and supplies needed for active viewer participation. Each workshop is correlated with specific standards from the 1989 NCTM standards. (Author/JRS) ENC-014210

Ordering Information
Annenberg/CPB, PO Box 2345, South Burlington, VT 05407
(802) 862-8881 / Fax: (802) 846-1850 / Toll-free: (800) 532-7637
www.learner.org
$24.95 per video
$199.00 per complete series (8 tapes/guide)

A Fractals Lesson for Elementary and Middle School Students

math.rice.edu/~lanius/frac/
Grades 4-8
1996
Author: Cynthia Lanius
Publisher: Computational Mathematics Laboratory (CMU), Rice University

Visitors to this web site can learn how to make fractals by iterating within an equilateral triangle. The site is written to conform to suggestions in the *1989 NCTM standards*. The goal is to explore mathematics and to find real-life objects similar to fractals, such as ferns, coastlines, and mountains. This lesson plan is designed so that students can work independently. Alternative assessment methods are suggested. Links to other fractal sites are available by clicking the appropriate word or phrase. (Author/LDR) ENC-002032

Chaos: A Toolkit of Dynamics Activities

Series: The Toolkit of Dynamic Activities
Grades 7-12
2000
Author: Jonathan Choate, Robert L Devaney

This resource book, part of the Toolkit of Dynamic Activities series, is written to help high school math teachers introduce the mathematical concept of chaos. It is designed to be integrated into programs of study in algebra, geometry, and precalculus. It consists of 10 lessons covering linear and nonlinear iteration with fixed points, cycles, and orbits through both graphical iteration and orbit diagrams. Each lesson starts with teacher notes giving detailed advice on how to plan for and organize the lesson. This is followed by the mathematical content of the lesson and blackline masters that lead students through a guided discovery of the content. Each lesson includes tips for the use of technology to enhance the lesson and concludes with problems for further investigation. For example, in the lesson on measuring population growth, students develop the logistic model of population growth. Students begin by looking at the exponential growth model before refining and improving that model. The lesson includes an explanation of both the exponential and logistic model as well as a discussion of the parameters of each model. Among the further explorations is a comparison between orbit diagrams for logistic models and for the quadratic iteration rule. Complete answers to the worksheets are provided as an appendix. (Author/MM) ENC-019103

Also available from this series are Iteration: *A Toolkit of Dynamics Activities* (ENC-019067), which covers such topics as prediction of financial growth, medicine absorption by the body, and fractal patterns; and *Fractals: A Toolkit of Dynamics Activities* (ENC-019066), which addresses such topics as self similarity, understanding and calculating fractal dimension, and the area and perimeters of fractals.

Ordering Information
Key Curriculum Press, 1150 65th Street, Emeryville, CA 94608
Email: orders@keypress.com
Fax: (800) 541-2442 / Toll-free: (800) 995-6284
www.keypress.com
$17.95 per book (paperback)
$59.95 per set of all four series titles

Fractals: Exploring Its Simplicity, Beauty, and Mathematics

www.best.com/~ejad/java/fractals
Grade 9 and up
1998
Author: Jacobo Bulaevsky
Publisher: Best Internet Communications, Inc.

Jacobo Bulaevsky, an electrical engineer and math hobbyist, maintains this web site of information and interactive Java Applets on 11 types of fractals and the mathematics behind them. The site demonstrates through graphics how each type of fractal is generated, then employs applets to help students visualize the iteration rules by allowing them to perform each iteration at the touch of a button. For example, in the Koch Snowflake Applet, students are shown a line. By clicking a button, students see how the line is changed after the first iteration; students can then perform successive iterations until their computer runs out of memory. After producing the fractal, students are asked about how the number of iterations relates to the number of line segments in the Koch Snowflake. Students are also given information about fractal dimension and other fractal concepts, such as the initial conditions and the algorithms that determine their shapes. To encourage student exploration, the site has windows that hide answers to the questions. These windows cannot be opened without a password, which teachers can receive from the webmaster. (Author/RMK) ENC-013353

Curriculum That Addresses Current Issues in Science

Energy Quest: Energy Education from the California Energy Commission

www.energy.ca.gov/education
Grades K-12
1995
Author: Bob Aldrich, Sue Foster
Publisher: California Energy Commission

The California Energy Commission developed this web site to cover various energy topics. A section of energy science projects contains topics such as using a lemon to power a digital watch and building a solar-powered hot dog cooker. Another section features puzzles and games for various age levels. Poor Richard's energy almanac provides explanations about energy from Ben Franklin. Visitors can find information about how their school can save energy and money. A section on fossil fuels contains information about the uses of coal, natural gas, and oil. The topics of geothermal, hydroelectric, nuclear, solar, and wind energy are presented. The energy story provides information on what energy is, where it comes from, how it is used, and how to save it. Also provided is information about the types of vehicles we'll be driving in the future and an advice column on energy and energy saving. Links to other energy and education related resources are provided. (Author/DEB) ENC-008738

NASAexplores: Express Lessons and Online Resources

www.nasaexplores.com
Grades K-12
2001
Author: Marshall Space Flight Center

This web site is designed to generate interest in and understanding of NASA's research and technology. Site designers are also striving to inspire the educational community by using the Internet to provide standards-based educational materials. Each week, NASAexplores provides two new teacher articles, which are then adapted to K-4, 5-8, and 9-12 grade levels. The web site also provides two or three lesson plans and activities per grade level that support the articles. Sample topics include fire detection units, a pill transmitter to monitor astronauts' vital signs, and solar-powered aircraft. An article from March 21, 2001, titled "Hamming It Up on the ISS," discusses the role of ham radios in communicating with crew members on the International Space Station Mir. In a sample activity for grades K-4, students make and test a simple radio wave generator using ordinary household materials. Grade 5-8 students demonstrate that radio waves cannot pass through certain metals, and grade 9-12 students identify the components of a radio wave and create waves in different frequencies. Each activity is accompanied by teacher sheets that provide background material and guidelines for conducting the activity. Learning objectives, a list of required materials, and correlations to the *National Science Education Standards* (1995) are also provided. (Author/LCT) ENC-019093

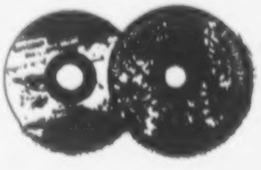
EPA Global Warming

www.epa.gov/globalwarming
Grade 5 and up
2000
Author: United States. Environmental Protection Agency (EPA)

The EPA maintains this web site to provide the most timely social, scientific, and logistic information available on the global warming issue. The homepage features four major sections that address climate science, greenhouse gas emissions, potential global warming impacts, and the actions conducted or supported by governments, businesses, and individuals that help address global warming issues. The climate section provides background information about climate change science, trends, and future projections of the climate change issue. The emissions section provides information on how people affect the mixture of gases in the atmosphere. The impacts section explains how climate change will affect the environment and the economy, including sea level rise, water quality, and agricultural changes. The actions section provides a wealth of information, examples, and case studies about what people at every level are doing to reduce the risks associated with climate change. Additional features include a series of state-specific information sheets on climate change and downloadable slide shows on climate science, emissions, and impacts. In addition, visitors can access the latest climate-related news, articles, speeches, and information about upcoming events. Also featured is a global warming kids' site where students learn about the difference between weather and climate, the greenhouse effect, and some of the ways that scientists gather evidence about climate. The kids' page also provides crossword puzzles and games for students to test their knowledge related to climate change. Every section provides links to related sites. (Author/YK) ENC-017591

Envision, Explore, Engage: An Interactive Science Experience

Grades 6-12
2001
Author: San Diego Supercomputer Center

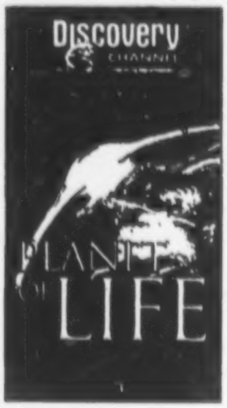


Part of the Envision, Explore, Engage program, this set of two CD-ROMs explores the worlds of computational and molecular science. The computational science unit presents research by scientists at U.S. laboratories such as the National Partnership for Advanced Computational Infrastructure (NPACI) and the San Diego Supercomputer Center (SDSC). A guided tour of the SDSC is provided, as well as a behind-the-scenes look at how a computer works. The scientific use of computers, from pattern visualization to data crunching, is also explained. Users visit a virtual computer hardware store and spend an allowance to build a system that performs various processing functions. Profiles of a musician, a computational chemist, and a computer animator highlight the ways in which computational science methods are used in the real world. The molecular science unit uses hemoglobin as a foundation for studying the field of bioinformatics, or visualization of the molecular world. An animated scale illustrates the relative dimensions of everyday objects, cells, and molecules. Students ride the scale-o-vater as they investigate the transportation of oxygen to cells at macro and micro levels. Computer simulations and hands-on activities describe the relationship between molecular activity and pressure, the logistics of x-ray crystallography, and the organ functions benefiting from these chemical processes. The program allows students to observe red blood cell structures in various species and to compare the solubilities of oxygen and carbon dioxide. Additionally, a group investigation of proteins is outlined. Links are provided to resources such as the Protein Data Bank and a guide to doing research. (Author/JG) ENC-019278

Ordering Information
San Diego Supercomputer Center, Attn: Donna Turner, UC San Diego, 9500 Gilman Drive MC0505,
La Jolla, CA 92093-0505
Email: info@sdsc.edu
(858) 534-5000 / Fax: (858) 534-5152
www.sdsc.edu
Free set of 2 hybrid CD-ROMS
Specify the number of copies you are interested in.

Evolution's Next Step

Series: Planet of Life
Grades 6-12
1998
Author: Akira Soma, Hidemi Hyuga, Masashi Tatabe, Yasuo Kubo, Yuichi Takayanagi



This videotape, developed for grades 6 through 12 as part of the Planet Of Life series by the Discovery Channel, discuses how humans have populated the Americas, how climate and global environmental changes have affected societies of humans, and what will be the future of our planet. The series is intended to explore the birth, evolution, and future of life on Earth. The videotape consists of two segments. The first covers topics including the methods of obtaining information about ancient weather patterns, the discovery of agriculture, and humans' adaptation to village life. The second segment discusses how discovery of agriculture changed human life and introduced excessive population growth and pollution of resources. The attempts to build self sustainable ecosystems and the possibility of making other planets such as Mars habitable for human life are also explored in this segment. The videotape emphasizes that humans are responsible for the planet and should carefully manage the biosphere in order to enable the evolution of life. Each segment ends with answers to study questions that are introduced at the beginning of the program, activity suggestions, and related resources. A Teacher's Guide containing curriculum focus, discussion questions, and vocabulary sections is included. (Author/FCM) ENC-018196

Ordering Information
Discovery Communications, Inc., PO Box 6027, Florence, KY 41022
Fax: (859) 727-8918 / Toll-free: (888) 892-3484
www.discoveryschool.com
$49.95 per video

The Search for Clean Air

Grades 6-12
1995
Author: David Solomon, Hugh Morton, Tom Sieg

The problems of air pollution are explored on this video, which covers topics such as the causes of pollution and its effects on forests, streams, and human health. The program also considers the issues involved in correcting the problems. Viewers are shown the consequences of air pollution in the northern and eastern parts of the United States and in Eastern Europe. Interviews are included with academics and scientists from the Environmental Protection Agency (EPA), the Harvard School of Public Health, the U.S. Forest Service, and the National Park Service. The video starts with a brief narration of the history of air pollution in the United States and in the world and continues with scenes of damaged forests with destroyed trees and acidified lakes with dead fish. The reduced visibility and the ozone problems that are associated with air pollution are also emphasized. The second half of the video focuses on the health hazards introduced by air pollution. The efforts of the U.S. government to reduce air pollution, including the Clean Air Act, are described. (Author/FCM) ENC-019198

Ordering Information
Films for the Humanities & Sciences, PO Box 2053, Princeton, NJ 08543
(415) 328-3825x239 / Fax: (609) 275-3767 / Toll-free: (800) 257-5126
www.films.com
$149.00 per video (can be rented for $75.00)

Critical Issues Forum (CIF): Students and Teachers Examining the Nuclear World

set.lanl.gov/programs/cif
Series: Los Alamos National Laboratory Critical Issues Forum
Grade 6 and up
1998
Author: Bill Robertson, Rich Alexander
Publisher: University of California and Los Alamos National Laboratory

The Los Alamos National Laboratory maintains this web-based curriculum for high school teachers and students to inform them about current, global issues facing the nuclear world. Topics for study include terrorism, nuclear weapons, and storage. Within each topic, a list of tasks is presented to engage students in critical research and analyses of scientific, economic, and political issues surrounding nuclear energy. Internet links, opportunities to email electronic mentors, and additional classroom activities provide assistance in the investigation process. A sample study in terrorism explores the motivations involved, the role of the media, and issues of security. Tasks require students to compare and contrast terrorism with local violent acts, create media presentations for a terrorist incident, and prepare a portfolio of responses to present at the "Student Conference on the Nuclear World." Suggested extension activities involve role-playing a terrorist situation and surveying the student population. Teacher resources include guidelines for implementing the curriculum, tips for conference portfolios, and evaluation rubrics. Additionally, samples of student work and correlations to National Science Education Standards (NSES) are provided. (Author/JG) ENC-018948

Life: The Search for Life on Venus and Mars

Series: Life in the Universe
Grades 7, 8
1996
Author: Seth Shostak

Developed as part of the Life in the Universe series, this kit engages students in a search for life, or signs of life, within our solar system. Students learn that life is not always intelligent, nor is it always easily recognizable. They explore Venus and Mars and learn why these two planets are the only ones in our solar system that could possibly harbor life. The teacher's guide includes background information, mission instructions, and reproducible worksheets for 14 different missions or activi-

ties. Students work in cooperative teams and build on the knowledge of previous activities. The complete set of activities should take five to six weeks of class periods. For the first activity, students watch a video, included with the kit, that compares Earth, Venus, and Mars. Also included with the kit is a series of graduated picture cards that allow students to explore scale and powers of ten. In subsequent activities, students culture and experiment with penicillin mold, examine soils and water, and test for organic compounds. The final activities ask students to consolidate their knowledge and design landing craft for Venus or Mars that will carry three different sensors to test for life. The teacher's guide also includes a glossary of terms, appendices listing materials and sources, and lab management tips. (Author/SSD) ENC-018900

Ordering Information
Teacher Ideas Press/ Libraries Unlimited, PO Box 6633, Englewood, CO 80155
(303) 770-1220 / Fax: (303) 220-8843 / Toll-free: (800) 237-6124
www.lu.com
$90.00 per kit (includes 1 paperback text, 6 card sets, 1 video, 1 poster)

Communities on the Prairie: Exploring Sustainability

Series: Communities on the Prairie
Grades 9-12
1999
Author: Kathleen Fimple, Mark Eifler, Timothy E. Mahoney, W. Cecil Steward
Publisher: NETCHE, Inc

This CD-ROM is intended to help students and teachers learn about the need for the sustainable development of communities, the trends and challenges communities face in the 21st century, and the various systems needed to sustain community development. To help in determining options for the future, users examine the history of today's communities in Nebraska. A section on sustainability provides background information about developing sustainable communities and discusses political, social, and economic perspectives on sustainability. Other sections describe different cities and towns in Nebraska, classifying them by community types that include rural, Native American, urban, ethnic, and institutional communities. The location, core economy, and values of each community are described. Maps, photographs, quizzes, and short videos supplement the text. A help section includes brief instructions for navigating through the program. (Author/FCM) ENC-019291

Ordering Information
Great Plains National, PO Box 80669, Lincoln, NE 68501
Email: gpn@unl.edu
(402) 472-2007 / Fax: (800) 306-2330 / Toll-free: (800) 228-4630
gpn.unl.edu
$29.95 per hybrid CD-ROM
Contact vendor for additional ordering information.

Fetal Alcohol Syndrome: Maternal Responsibility for Health of Fetus

Series: Bioethics Forums
Grade 9 and up
1999
Author: Mark Lorvok, director

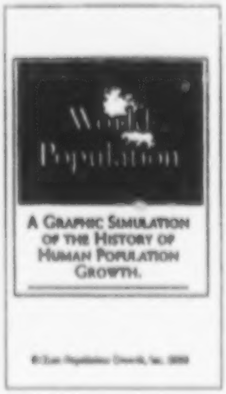
Tackling the issue of fetal alcohol syndrome, this CD-ROM leads students through a process to decide who has the responsibility for the health of a fetus when the pregnant mother wants to consume alcohol. The Bioethics series explores societal dilemmas arising from recent breakthroughs in biology, genetics, and biomedical technology. The program is organized into a four-step decision-making process in which the students define the context of the issue, identify the objectives and values of the stakeholders, and explore possible alternatives and tradeoffs while developing a consensus-based solution. As they progress through the CD-ROMs, students see video clips of a diverse group of people who express differing opinions related to issues associated with the introductory scenario. Students are asked to consider different viewpoints and weigh the consequences of various decisions while they evaluate their own ideas and sharpen their communication skills.The issues on this CD-ROM are introduced by a restaurant owner who is concerned about a possible lawsuit brought by a disgruntled pregnant patron. The patron is angry because the waiter advised her about the dangers alcohol consumption posed to her unborn child. Students then view video clips of the patron, the waiter, and a teacher who feels that society is sending its problem children into the school system to be fixed. To gain a deeper understanding of one aspect of the conflict, users select from issues such as the dangers of alcohol, the special concerns of people with phenyketonuria (PKU), and individual freedom versus societal control. The students reflect upon the video segments and other resources as they answer questions and record notes in an electronic journal. Vocabulary terms are hyperlinked to a glossary. A teacher's utility section on the CD-ROM has a scoring guide with a rubric for the students' responses to the questions. Implementation strategies are available in both the CD-ROM and its user manual. (Author/JR) ENC-018955

Other titles in this series include *Genetic Screening: Employee Rights Vs. Public Safety* (ENC-018912), *Breast Cancer Susceptibility: Acting on Incomplete Research Data* (ENC-019196), and *Gender Selection: Using Genetic Information to Choose a Child* (ENC-019197).

Ordering Information
Videodiscovery, Inc., 1700 Westlake Avenue North, Suite 600, Seattle, WA 98109
(206) 285-5400 / Fax: (206) 285-9245 / Toll-free: (800) 548-3472
www.videodiscovery.com
$59.00per CD-ROM (Windows) with user manual
$249.00 for a five-disc lab pack is, complete series pack is $599.00. Contact vendor for quantity discount pricing.

World Population: A Graphic Simulation of the History of Human Population Growth

Grade 9 and up
2000
Author: Paula de Andrade, E. Scott Tance


World Population
A Graphic Simulation of the History of Human Population Growth

This video provides an overview of the history of global population growth. The program contains a graphical simulation of the human population growth in which, as the years roll by on a digital clock from 1 A.D. to 2030, dots light up on an illustrated map to represent millions of people added to the population. Historic references on the screen, such as the Roman Empire and Rise of Islam, place population changes in context. The videotape also provides an activity guide that can serve as a starting point for a closer examination of human population dynamics and their environmental and social impacts. (Author/FCM) ENC-018610

Ordering Information
Zero Population Growth Inc., 1400 16th Street NW, Suite 320, Washington, DC 20036
Email: info@zpg.org
(202) 332-2200 / Fax: (202) 332-2302 / Toll-free: (800) 767-1956
www.zpg.org
$19.95 per video with activity guide

Chances' Choices

Grades 10-12
1997
Author: A. Merrill Henderson, Edward R. Glass, Kelly Hickey, Paula K. Haddow, Richard Lord, Robert Woo, Suzanne Bosse

The story of the Chance family is the focus for this interdisciplinary curriculum unit, which considers human genetic conditions as a springboard for discussing their related social, economic, and ethical issues. The extended family saga begins when Paul and Stacy Chance give birth to their daughter, who was diagnosed with phenyketonuria (PKU). The curriculum unit is designed to engage students in the Chances' stories, while introducing the concepts related to human genetics. It is formatted to require minimal teacher preparation and to make connections with other disciplines, such as mathematics, language arts, and history. Each of the 12 scenes introduces the characters, concepts, and conditions. A box listing specific objectives heads each scene and is followed by background information and the lesson guidelines. The unit contains more than 150 boxed teacher notes that include trivia tidbits, extra information, and teaching suggestions. Questions for discussion, activities for assessment and enrichment, and references follow each scene. In one of the scenes, Paul has a heart attack and is diagnosed with familial hypercholesterolemia (FH). Overheads show the inheritance pattern of autosomal dominant traits, the faulty receptor mechanism resulting from FH, and a comparison of clear versus clogged arteries. Teachers can find background information about aspect of the disease such as its clinical symptoms, pathogenesis, prognosis, and prevalence. The scenario continues with the fact that Paul's late, younger brother had fragile X syndrome and that his two sisters have opposing views about testing for possible genetic disorders. Students are asked if employers should require testing and if Paul's sister should be persuaded to have her blood tested for FH. Suggested research topics include investigating the environmental effects on a person with FH and studying defects caused by abnormal numbers of sex chromosomes. Writing assignments, portfolio projects, enrichment activities, and guest speaker topics extend the discussions about nutrition, cholesterol, and heart disease. A glossary and list of genetics web sites are included. (Author/ JR) ENC-017836

Ordering Information
Foundation for Blood Research, 69 US Route One, PO Box 190, Scarborough, ME 04070
Email: ekloss@fbr.org
(207) 883-4131 / Fax: (207) 883-1527
www.fbr.org
$75.00 per book (loose-leaf)

Industrial Systems of Tomorrow: Finding Sustainability Through Natural Cycles

Grade 10 and up
1998
Author: Ron McGreal

This video examines the nature of industrial ecology and highlights ways in which New England manufacturers have alleviated many of the environmental problems associated with materials production. Using innovative product designs and management systems, companies such as The Robbins Company, Tom's of Maine, and Stonyfield Farm demonstrate how the process of positive change can be made with small adjustments in procedures and perspectives. Dr. Joseph Larson, a researcher at the University of Massachusetts--Amherst, underscores the importance of understanding natural mechanisms of detoxification and recycling as the key to industrial waste management. Bruce Sheridan, plant manager of featured company the Digital Equipment Corporation, explains how products are now disassembled and reused, rather than thrown away, to minimize hazardous waste. The program discusses ISO 14,000 Environmental Management System guidelines, as well as their impact on pollution prevention. The necessity of shared vision is also addressed, emphasizing the critical need for commitment throughout all work levels. (Author/JG) ENC-019379

Ordering Information
The Video Project, PO BOX 77188, San Francisco, CA 94107
Email: video@videoproject.net
(415) 284-0600 / Fax: (415) 821-7704 / Toll Free: (800) 475-2638
www.videoproject.net
$59.95 per video

Water on the Web

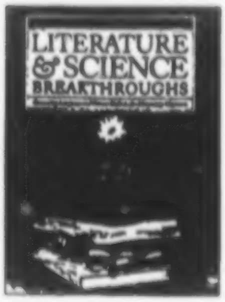
www.nrri.umn.edu/wow/index.html
Grade 10 and up
2000
Author: Natural Resources Research Institute (NRRI)
Publisher: Department of Education, University of Minnesota, Duluth

The technologies accessible on this web site give students the opportunity to learn basic science through hands-on science activities in the lab and in the field. The site contains lessons that use the aquatic environment and real lake data to explore science concepts through both directed study and an inquiry approach. The directed studies allow students to apply and learn concepts through guided experiences. The inquiry lessons provide a more open-ended opportunity for students to discover the same concepts. The student and teacher lesson plans are organized into six sequential components that include: knowledge base, experimental design, data collection, data management and analysis, interpretation of results, and reporting results. The site also contains online tutorials that explain concepts in limnology, navigation on the site, and ways to use the computer program EXCEL for data analysis. Movies in the limnology tutorial show how salinity and temperature affect water density. Real water-quality data can be obtained through the project's Remote Underwater Sampling Stations (RUSS). Currently data is being posted from five RUSS units that are located in four Minnesota lakes. Visitors can access data sets about specific lakes by using a search engine on the site. One lesson about fish stocking decisions integrates the ideas of dissolved oxygen levels, water temperature, and fisheries management strategies. The students following the directed study path read background information and complete exercises outlined on the handout provided. Those who choose to do an investigation play the part of a fisheries biologist as they collect, analyze, and present their management decisions. (Author/JR) ENC-016975

Innovative Science Instruction

Literature and Science Breakthroughs: Connecting Language and Science Skills in the Elementary Classroom

Grades K-6
2000
Author: Jo-Anne Lake



The strategies offered in this book are designed to help teachers use fiction and nonfiction books to teach science skills and principles. The book provides a variety of hands-on activities that connect children's literature to science concepts in the real world. The book is organized around five main strands in science: life systems, matter and materials, energy and control, structures and mechanisms, and Earth and space systems. Throughout the book, reviews and recommendations for children's literature can be used in each learning strand. The book begins with an introduction that provides the framework for implementing a literature-based approach in teaching science. The first four chapters present the advantages of using the approach, a method for integrating literature and science, suggestions for getting started, and information about strategies, tools, and applications that are appropriate for this kind of approach. These chapters are followed by specific suggestions for the literature and hands-on activities for each learning strand. For each topic, the book gives a statement of learning expectations, a sequence of key questions, and a topic organizer that provides an overview of the topics and the recommended books. Every key question includes key concepts, a teaching outline, a planning web, hands-on activities, and suggestions for evaluation strategies. In a sample lesson, students read Butterfly House, which traces the life cycle of a butterfly. Students then discuss the concepts of time, growth, and change as they relate to the life cycle of a butterfly. In a following hands-on activity, students raise a butterfly from a caterpillar to investigate the growth and development of a butterfly. An annotated bibliography and a list of additional resources are also included. The book concludes by discussing a model that integrates topics from the five science strands. (Author/YK) ENC-019089

Ordering Information
Stenhouse Publishers, PO Box 1929, Columbus, OH 43216
Fax: (800) 833-9164 / Toll-free: (888) 363-0566
www.stenhouse.com
$18.95 per book (softcover)

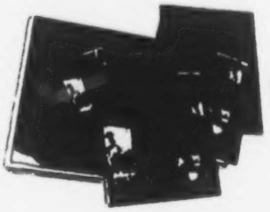
KidScience

kams.mhpcc.edu/kids2/
Grades 5-8
2000
Author: Patty Miller
Publisher: Maui High Performance Computing Center

Housed at this web site are materials related to an interactive distance learning science program for students in grades 5-8. The lessons that correspond to the online documents are delivered into the classroom via television in either live or taped versions. The schedules for the programs are provided on the site. Teacher's guides accompany the lessons and provide background information and student activities. The activities have web addresses where students can find additional information about the lessons or interact with experts in the field. Worksheets and diagrams are provided in the activity materials. Students can communicate with one another through the site's topic-specific bulletin boards. The described programs cover topics such as oceanography, wetlands, and life on a space station. The site correlates the activities to standards documents. (Author/JR) ENC-018342

CORD Biology: Science in Context

Series: Center for Occupational Research and Development
Grades 9-12
1997
Author: Addison Wesley Longman, Inc.
Publisher: South-Western Educational Publishing



This curricular kit presents biological concepts in the context of careers and real-world problems. The kit includes a textbook, a laboratory manual, an assessment package, and a videotape that can be used to introduce each of the units. Teaching tips and materials are provided in a teacher's resource book and a teacher edition of the text. The kit emphasizes the role that contextual and cooperative learning play in facilitating students' efforts to connect new concepts to existing knowledge and to the world outside the classroom. Each chapter of the text begins with a two-page spread that explains why the students should learn the material, lists learning objectives, and offers a specific example of what is covered in the chapter. Readers can find interviews with people who have careers related to the topics in the chapter. The text highlights changes in scientific thought to illustrate that biology is not static. Scientific terms are defined in margin notes. Hands-on activities, designed to be done in small groups, require the students to use process skills such as observation, measurement, and classification. The lab manual has investigations that involve procedures or modifications of procedures used by scientists and technologists in a variety of fields. The teacher's resource book contains objectives, assessment rubrics and masters, and blackline masters and chapter notes. (Author/ JR) ENC-018934

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$53.95 per student text (hardbound)
$84.95 per teacher's annotated edition (hardbound)
$105.95 per teacher's resource book (hardbound)
$89.95 per video
$14.95 per laboratory manual (softcover)
$149.95 per user's manual and test printouts text (softcover) with 1 hybrid CD-ROM

Holt Science Spectrum, a Physical Approach

Series: Holt Science Spectrum
Grades 9-12
2001
Author: John Holman, Ken Dobson, Michael Roberts

This book is the annotated teacher's edition of the Holt Science Spectrum program. The program is designed for the lower secondary grades as a general science course covering chemistry, physics, Earth science, and space science with a focus on physical science. Each chapter of the teacher's edition begins with a section that shows how to integrate cross-disciplinary subjects such as reading, mathematics, and technology. A planning guide gives a quick overview of print resources, labs, and technology available for the chapter. The annotations for the student text include skill-building tips, teaching tips, and multicultural connections. Misconception Alerts describe common misconceptions that students may have about a topic and provide tips on dispelling these misconceptions. Other features include alternative assessment strategies, experiments that teachers can demonstrate, and historical perspectives, as well as answers to review questions. The book provides correlations with the *National Science Education Standards* and a section on safety in the laboratory. (Author/FCM) ENC-019252

Ordering Information
Holt, Rinehart and Winston, Inc., 6277 Sea Harbor Drive, Orlando, FL 32887
(407) 345-3000 / Fax: (800) 269-5232 / Toll-free: (800) 225-5425
www.hrw.com
$73.35 per teacher's annotated edition (hardbound)

Virtual Labs and Simulations: Great Websites for Interactive Learning

www.hazelwood.k12.mo.us/~grichert/sciweb/applets.html
Grades 9-12
1999
Author: Gary Richart
Publisher: postnet.com

This web site hosts a variety of online demonstrations and simulations in physics. The site features classroom links to numerous applets that are used in lectures and labs as a way to demonstrate visually difficult science concepts. The goal is to help science students use the Internet as an information resource, especially science information and homework assistance. Types of links include ShockWave Physics Simulations, Java Applet simulations and animated demonstrations that enable students to perform interactive simulations of physics problems from the real world. Topics covered include mechanics, momentum, and thermodynamics, in addition to rotational mechanics, machines, and fluid physics. For example, in the mechanics area students analyze the description of motion depends on the frame of reference while watching moving objects from different vantage points. They also investigate uniform velocity (no acceleration) and uniform acceleration as they visualize the graphs of motion that they assign to an object. In another lab activity about free fall, students collect data to determine the free fall time in a vacuum (or sometimes in air) for objects with different masses. The site also provides links to information that include useful physics resources on the Internet and physics notes. (Author/YK) ENC-016555

Unseen Life on Earth: An Introduction to Microbiology

Series: Unseen Life on Earth
Grade 9 and up
2000
Author: Berdell R. Funke, Christine L. Case, Gerard J. Tortora
Publisher: Addison-Wesley Longman, Inc

This microbiology curriculum kit includes a microbiology textbook, telecourse faculty and student guides, and a twelve-part video series, as well as two supplementary CD-ROMs. The textbook covers topics ranging from fundamental principles to human disease. Each chapter contains a study outline of concepts, critical thinking questions, and a discussion of clinical applications. The student tutorial CD-ROM extends learned concepts by presenting visual representations of microbial processes and defining key terminology. A pronunciation section and quizzes for each chapter are also provided. The video program follows scientists around the world as they discover and study the impact that microorganisms have on the world. Simulations, analogies, and real-world applications are used to illustrate the genetic code, antibiotic resistance, and cross-contamination. One video, Microbial Ecology, explores the role of microbes in ecological systems. The downfall of Biosphere Two is highlighted, as well as the effects of polluting waterways. University of North Carolina professor Hans Pearl describes the need for biological balance in an estuary, while microbiologist Terry Hazin investigates possible solutions to the problems of solid waste disposal. The student guide supports the series with video questions, exercises, and short answer questions. There are also recommended readings from the book and suggested experiments. The faculty guide contains all of the information in the student guide plus answer keys. Additionally, a Bacteria ID CD-ROM allows students to perform computer-based laboratory tests to identify unknown samples of microorganisms. (Author/JG) ENC-019194

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www.learner.org
$499.00 per kit
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$25.00 per faculty guide
Call vendor for details and additional ordering information.

Environmental Science: Earth as a Living Planet

Grades 10 and up
2000
Author: Daniel B. Botkin, Edward A. Keller

This textbook presents an updated introduction to important and useful concepts in the study of the environment. The book explores vital environmental issues and considers why they are important and how we might solve them. Topics include basic issues in environmental science, ecological communities, and sustaining living resources. The book also covers fossil fuels and the environment, global warming, and environmental economics. Additional areas of interest include how our planet works as a system, what our values are, and which potential solutions are socially just. Each chapter begins with a statement of learning objectives and a case study that presents important questions on the subject matter. Special learning modules provide more detailed information on specific concepts or issues. Each chapter ends with a discussion of an environmental issue and provides critical thinking questions for the students. In a sample chapter, students learn about the greenhouse effect, the global warming controversy, and potential effects of global warming. They are then prompted to examine factors that need to be considered in determining the planet's carrying capacity, such as food supply, land resources, water resources, and technology. Each chapter also includes suggestions for further reading and Internet resources. A glossary and an index are included. (Author/YK) ENC-018873

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$103.95 per book (hardcover)

Integrating Technology

National Educational Technology Standards for Students: Connecting Curriculum and Technology

Grades K-12
2000
Author: Don Knezek, Gary Bitter, Lajeane Thomas, M.G. (Peggy) Kelly

Teachers, technology planners, teacher educators, and others can use this book for frameworks, standards, and performance indicators to help enrich learning environments with technological support. The book contains descriptions of the technology foundation standards for students, activities that facilitate the integration of the standards into the curriculum, and multidisciplinary resource units that are sequenced for the *National Education Technology Standards (NETS)* within grade level ranges. Performance indicators are listed and correlated to six standards for each grade range. The book provides scenarios and examples to illustrate how teachers have incorporated the performance indicators into their lessons. Another section of the book focuses on how technology can be used to enhance discipline-specific curriculum. This section offers suggestions about how to manage classrooms that are equipped with different amounts of computer hardware and software. The book provides the purpose, preparation, and procedures involved in the activities as well as the tools and related resources. Each step of the procedures is correlated with discipline standards and grade level-specific *NETS* performance indicators. Assessment ideas are included. Appendices contain both the *NETS* for students and the standards for the curricular areas, a *NETS Workshop Staging Guide*, and information on the *NETS* Project Partnership. Lists of additional resources and a glossary are provided. (Author/JR) ENC-016551

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www.iste.org
$29.95 (spiral-bound, paperback)

Engines for Education

Grades K-12
1995

The authors of this book draw on their background in cognitive psychology to support their analyses of the problems in the current learning system and suggestions for change with the software produced at their home institution, The Institute for Learning Sciences. The book begins with a call for change by

identifying the flaws in classroom learning and listing the top 10 mistakes in education. It then presents a model that incorporates five learning architectures with the authors' description of the natural learning process. Each of these architectures is explained with examples of computer software that could support it. Images of the computer displays illustrate the benefits that the programs provide the students. For example, a chapter about learning by doing discusses how simulation programs can make the students feel they are experiencing events that might be impractical in reality due to danger or expense. It shows how students could use the program DUSTIN to learn a foreign language. That program offers users a series of tasks, each of which requires them to employ language to accomplish a concrete goal. The book finishes with predictions about the fate of print material and home video. The authors comment about the future usefulness of their own book and talk about the options available in its web and CD-ROM presentations, with hyperlinks to each of the topics. The book offers eight suggestions to improve the schools of tomorrow and presents the Student's Bill of Rights. (Author/JR) ENC-017856

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www.erlbaum.com
$26.00 per book

Windows on the Future: Education in the Age of Technology

Grade PreK and up
2001
Author: Ian Jukes, Ted McCain

Educators can use this book in their process to adapt to the increasing demands of advancing technology. The book outlines barriers to accepting change, including personal paradigms, life experiences, and information overload; the authors also address frameworks for overcoming these barriers. A self-assessment quiz is provided to help readers identify their position on the technology continuum and recognize how perceptions of education have changed from the industrial era to modern day. A sample chapter discusses how the effects of globalized information, technological fusion, and personal computing power have influenced, and will continue to influence, the ways in which children are educated. A train and a rocket are used as metaphors to help explain how the world has changed and to highlight how schools have lacked an appropriate response. Envisioning education as a dynamic process, unrestrained by time or place, the authors provide curricular suggestions to assist in the transformation process. (Author/JG) ENC-019216

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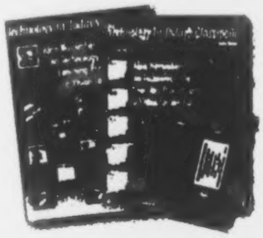
www.corwinpress.com
$27.95 per book (paperback)

Technology, the Learning Process and a Vision for the Future

Series: Technology in Today's Classroom Video
Grades K-12
1997
Author: Alan November, Craig Arnold, Kathy Winberry, Teresa Langness



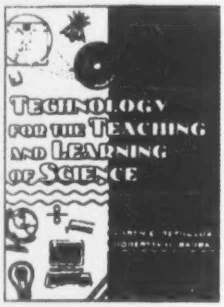
Part of the Technology in Today's Classroom Video series, this video and leader's manual feature two programs in which Alan November talks about the current changes in education and workplace environments as well as technology's role in those changes. The series is designed to offer a glimpse of the potential of new and existing technologies and to provide educators with practical instruction on how to better infuse technology into their teaching practices. November discusses the fact that employers no longer want employees to come to a prescribed place and work in a predetermined way. He points out that education needs to respond so that students will have the skills to perform in the emerging work environments. He cites examples of situations in which new technology has been used to automate a previous model and calls for educators to use computers to "informate," or change their mind set about, their present strategies. Finally, he addresses ways that teachers can turn their fears of technology into opportunities to respond to the expanded role of learners. Interspersed throughout November's presentation are video clips of interviews with people in the business community and with teachers who have used computers to develop different skills in their students. The leader's guide contains suggestions and materials to conduct workshops. Readers can find materials lists, preparation ideas, and recommendations for customizing the presentations. The key points in the video are outlined and scripts for the workshop presentation are provided. Also included are reproducible pages that can be used as overhead transparencies and activity worksheets. (Author/JR) ENC-018312

Ordering Information
Canter & Associates, PO Box 66926, Los Angeles, CA 90066
Fax: (310) 578-4700 / Toll-free: (800) 262-4347
www.canter.net
$179.00 per video with leader's manual

Technology for the Teaching and Learning of Science

Grades K-12
1996
Author: Karen Reynolds, Robertta H. Barba

Education professionals can use this book to learn about effective integration of technology into science instruction. The authors emphasize both the importance of invisibility of technology during the instruction as well as the fact that the technology and science should be accessible to all teachers and students. The text discusses instructional techniques that enhance student-centered learning. The book uses student science and teacher reflection activities to help demonstrate how to employ various instructional technologies and to address teacher issues, such as assessment, classroom management, and



instructional planning. Each chapter provides extension activities, connections with the other chapters, and suggestions for further reading. In one chapter, the book suggests using video cameras, microscopes, and stroboscopes to extend the students' vision. The activity tells students to compare the observations they make with their unaided eyes to those they make while viewing a slow-motion video of water balloons being popped. A chapter about keeping student records asks teachers to set up a database that they can use for collecting student science profile information. Figures, tables, and cartoons are used throughout the book to illustrate ideas. A list of teacher resources and a glossary with scientific, technological, and education terms are included in the book. (Author/JR) ENC-016973

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$35.00 per book (paperback)

Young Children Using Calculators

Grades PreK-3
1996
Author: Jill Cheeseman, Susie Groves
Publisher: Deakin University

A professional development tool, this 45-minute video shows how calculators have been used by teachers in grades K-3 to enhance children's learning of mathematics. The video shows lessons given by teachers in three primary schools (in Australia and Vermont) in which children are allowed or encouraged to use calculators. The children, ages four to eight, are shown using calculators for the first time to count, to explore and record numbers, to solve real problems, to investigate patterns, and to play. The teachers who were videotaped shared how their teaching practices and beliefs were changed by using the calculators. They report that the use of calculators adds another dimension to students' experiences with numbers and reveals that children were capable of understanding more about numbers than the teachers had previously thought. The participants also reveal that using calculators frees children to explore what they want to know when they are not limited to the numbers they can represent with their fingers or other counting tools. In conclusion, the teachers now report feeling that teaching without calculators would be unfair to their students. (Author/GMM) ENC-005781

Ordering Information
Centre for Studies on Mathematics, Science and Environmental Education, Faculty of Education, Deakin University, 221 Burwood Highway, Burwood VI 3215
$26.20 per video plus $6.84 U.S.) for shipping. NTSC format

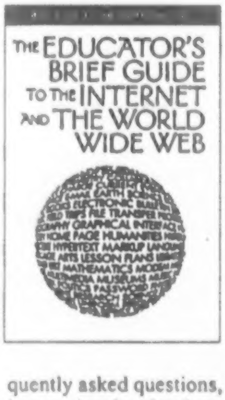
Digital Divide Network

digitaldividenetwork.org/content/sections/index.cfm
Grade K and up
2001
Author: Benton Foundation

This web site offers a range of information, tools, and resources designed to help bridge the digital divide. The term "digital divide" refers to the gap between those who can effectively use new information and communication tools, such as the Internet, and those who cannot. This site looks at the causes and effects of the digital divide from four distinct angles: technology access, literacy and learning, content, and economic development. In each of these areas, particular attention is paid to the role of local individuals and organizations when it comes to bridging the divide. In many cases, the stories featured on the Digital Divide Network come directly from the people working on this problem at the local level. The site also serves as a forum where practitioners can share their experiences with colleagues around the world. (Author/JRS) ENC-019219

The Educator's Brief Guide to the Internet and the World Wide Web

Grades K-12
1998
Author: Eugene F. Provenzo, Jr.


THE EDUCATOR'S BRIEF GUIDE TO THE INTERNET AND THE WORLD WIDE WEB

Educators can use this book to learn how to integrate the Internet and World Wide Web into their curriculum. The text is designed to provide information about technical issues and to serve as a directory of Internet sites. In it, the author explains how to get connected to the Internet and how to access information beneficial to students. Grayscale boxes highlight recommended web sites, which include electronic books, virtual field trips, and collaborative projects. Boxes scattered throughout the book provide answers to frequently asked questions, such as what baud rate is or why instructional technology has so often failed. The book suggests subject specific ways to integrate the Internet into the curriculum. For example, it lists a site where science students can perform virtual frog dissections. Model Internet lesson plans outline the purpose, themes, and competencies that are met by the lesson. A section on netiquette, acceptable use policies, and child safety online teaches educators how to avoid problems associated with Internet use in the school. The book also explains how to set up a web site to share the teacher's lesson plans, students' field trip experiences, and examples of project work. (Author/JR) ENC-017326

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Eye On Education, 6 Depot Way West, Larchmont, NY 10538
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$25.95 per book (paperback)

The Teacher's Complete and Easy Guide to the Internet

Grade PreK and up
1999
Author: Ann Heide, Linda Stilborne, Val Johnston

This book is designed to help teachers identify how the Internet can be used to enhance learning. It has lesson ideas, tips, and step-by-step instructions for both novice and experienced users. The authors discuss Internet tools, ways to integrate the Internet into the curriculum, and security issues. Readers can also find information about strategies to use with special needs students, ways to network with colleagues, and places that have funding opportunities. Icons identify teacher tips, project ideas, and technical points. Teacher quotes are used to guide and motivate the readers. The authors suggest that all readers use the first chapter to become familiar with the Internet and then select other chapters when they need information about how to use the Internet in specific ways. Each chapter begins with a list of goals in grayscale boxes. Project ideas identify the learning outcomes, grade levels, and instructions on how to begin the activity. Teachers are also given ideas to develop and extend the projects. Screen images of the discussed web sites are found throughout the book. A glossary defines technical terms. The accompanying CD-ROM includes an extended version of the appendix printed in the book, along with links to lesson plans, shareware, and technical help. (Author/JR) ENC-017454

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StudyWorks! Online

www.studyworksonline.com
Grades K-12
2001
Author: MathSoft, Inc.

At this web site, students can explore the math and science behind everyday activities such as sports and photography. Sections titled Explorations, Just For Fun, and News and Links offer lessons and interactive activities for students and teachers. Explorations include using discrete mathematics to analyze traffic patterns, investigating air quality issues, and learning about natural selection. Some of the free activities require the use of software that can be purchased from the site developers. The site also contains online courses available for a fee. Course material is organized as integrated collections of learning materials on topics in engineering, mathematics, and science. Courses include pre-algebra and algebra I, calculus, statistics, biology, chemistry, and physics. Understanding Polls is an example of the free units available online at this site. In this unit, students learn to design polling questions, sample a population, and investigate margin of error. Other sections in this unit look at classic polling errors such as the Roosevelt and Truman election predictions and the 1998 Minnesota governor's race. The Just for Fun section contains puzzles and games such as Crypto, a timed code breaking activity, and the logic game, Rock Slide. (Author/JRS) ENC-018928

The Copernicus Education Gateway: Harnessing the Internet for the K-12 World

www.edgate.com
Grades K-12
1999
Author: britannica.com
Publisher: Copernicus Interactive, Inc

This web site contains tools, resources, and links to help parents, teachers, and students organize and locate information, projects, and products. Some of the site's 10 sections contain content information, while others offer tools for collaboration, distance learning, and telecommunication. Visitors can find links to online adventures, virtual field trips, and projects. Teachers can post their own ideas or view others' suggestions about how to use the tools on the site. A School Notes section allows teachers to set up accounts where they can post notes, homework assignments, and flashcards on the web. A curriculum matrix allows teachers to view standards with related lessons for specific disciplines and grade levels. They can submit their own lessons to be included in the matrix for a particular benchmark, create a new lesson plan, or use a hyperlink to access the lessons submitted by other teachers. The site can be customized for a particular school so that staff can retrieve lessons designed to correlate with their own state standards. The site also contains an adaptation of WebCT with which teachers can create their own online course with quizzes, private chat classrooms, and student tracking tools. Through the online course, teachers can track which pages the students have viewed, manage grades, and view student multimedia presentations. Links to search engines, current news articles, and reference materials are available throughout the site. (Author/JR) ENC-017317

Virtual High School: Bringing Innovative Education to the World!

vhs.concord.org/
1998
Grades 9-12
Author: Mark McGrath
Publisher: the Concord Consortium

A collaborative project of high schools from around the country, this web site offers online student courses in the arts, science, language arts, and technology. Online courses range from advanced academics to technical and specialized courses, such as Connecting Mathematics and Science through Technology and Malaria: A Case Study. This web site models an actual high school by offering student and faculty communication via email and an online yearbook and newspaper. Other resources include a catalog of available courses, a demonstration course illustrating how VHS courses are organized, a faculty guide, and a handbook with detailed information about policies and procedures. Participating schools donate computers, Internet connectivity, and staff time. Twenty students can be enrolled for each course contributed by a teacher. Quality of instruction is maintained by requiring each teacher to complete a graduate-level course online that is designed to highlight educational strategies and technologies for online instruction. Each participating school also provides a VHS site coordinator who is responsible for project management and support of teachers and students at their local school. (Author/JRS) ENC-015730

21st Century Tech Tools

Filamentality: Helping You Add Your Own Filament to the Web of Learning

www.kn.pacbell.com/wired/fil
Series: Pacific Bell Knowledge Network Explorer
Grades K-12
2001
Author: Pacific Bell

The online lessons at this web site help educators create web-based activities for their learners. Visitors are guided through the complete instructional design process, including picking a topic, searching the web, gathering good Internet sites, and turning web resources into learning activities. Teachers can create web-based learning pages that include their choice of Internet links and activities focused on achieving a specific goal. Users can make five different kinds of web-based learning pages: a Hotlist, a Multimedia Scrapbook, a Treasure Hunt, a Subject Sampler, and a WebQuest that presents students with a challenging task, scenario or problem to solve. The main steps of creating a web site include registering a topic, adding links, and creating an activity. After registering a new topic, visitors can start a file and edit their basic information. Users then collect links to Internet sites related to their topic and use those links to create an activity. In each stage, interactive pages allow the teachers to edit or customize their web page. The site also provides links to popular search engines, general tips on picking links, information about categorizing links into groups, and samples of different activity formats. Visitors can also register their web site by submitting it to the Filamentality Registry database. These sites are reviewed for the quality of links and their educational value. Visitors can search the database for an existing topic by a variety of criteria, including grade level, activity type, and subject. (Author/YK) ENC-018920

Mission to Planet X

Series: Internet Coach
Grade 3 and up
1997
Author: APTE, Inc.

Part of the Internet Coach series, this CD-ROM and teacher's guide develop students' computer skills while introducing them to the solar system. The series integrates lessons about using the Internet with science content. This CD-ROM contains a game in which students try to rescue a Star Surfer from Earth who is held captive on the Planet X. To rescue the surfer, the players must perform functions within a simulated Internet format. For example, on one of the planets the student has to get information from participants in simulated chat rooms. If they ask the right questions to the right people, the students will get a hatch code number. With the hatch code the players gains entrance to a puzzle, such as one in which tiles have to be manipulated into the proper configuration before a nuclear reactor explodes. After successfully completing the puzzle, the players receive a piece of equipment that is necessary for their mission on Planet X. The teacher's guide contains the hatch codes for each planet. The teacher's guide also has background information about each planet and reproducible activities that encourage students to explore information about the solar system. During their simulated stay on Mars, the students write an email to get the hatch codes. In an associated activity, students calculate their weights and ages on different planets using information in the guide. They identify the parts of an email message and send a question to a NASA scientist. Web site addresses are included so that students can send an electronic planetary puzzle greeting card as an extension to the lesson. A table correlates the activities to the *National Science Education Standards (NSES)* and the 1989 NCTM standards. A glossary, technical information, and an Internet safety pledge are included. (Author/JR) ENC-017080

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Evanston, IL 60201
Email: joanie@apte.com
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www.apte.com
$59.95 per CD-ROM package (includes teacher's guide)

Let's Do Math: Tools and Things

Grades 4-12
2000
Author: MathResources, Inc.

The interactive mathematics dictionary on this CD-ROM features a built-in grapher and calculator. More than 1,100 terms are defined, many with applets to illustrate the definition interactively. The CD defines mathematical terms such as square root, and also well-known mathematical puzzles like the Towers of Hanoi problem. The definitions are cross-referenced with hyperlinks and can be accessed alphabetically or by subject, such as algebra, arithmetic, geometry, measurement, and number theory. Some of the entries contain questions that allow users to practice the concept defined. The grapher can be used to create function graphs, parametric graphs, box and whisker plots, pie charts, curves of best fit, and inequalities. The calculator has many functions that allow users to minimize and maximize functions numerically, perform matrix operations, calculate the results of binomial experiments, and calculate the mean of a list of numbers. The accompanying user's guide gives a complete account of all the grapher and calculator functionalities. Also included are notes on the structure of the interactive dictionary. (Author/MM) ENC-019283

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Video Resources Software, 11767 South Dixie Highway, Suite 222, Miami, FL 33156
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(305) 246-0116 / Fax: (305) 256-0467
Toll-free: (888) 223-6284
www.acemath.com
$129.95 per hybrid CD-ROM
Lab Pack (5) is $395.00; Lab Pack (10) is $595.00. Network 30-station $1,295. Resource Guide (extra copies) $21.95

Calculator Based Laboratory 2

Grades 6-12
2000
Author: Texas Instruments Incorporated

This hand-held, calculator-based, data collection system can be used with a Texas Instruments TI-73, TI-82, TI-83, TI-83 Plus, or TI-85 graphics calculator. Data collected by the portable CBL unit can be retrieved and analyzed by the graphing calculator. The portability allows for versatile collection and analysis of real-world data in the lab or in the field. Students can gather a variety of data using probes, three of which are included: temperature, light, and voltage. The system can also be used with many other probes, purchased separately, that would allow them to measure force, sound, pH, and other characteristics and phenomena. The CBL2 comes with DataMate software already loaded that contains the basic information needed to run experiments. The system has many capabilities, including computing first and second derivatives on collected data and computing minimum, maximum, mean, and standard deviation statistics values. Absolute or relative time is recorded as data are collected, and data-smoothing algorithms are built in. Graphs may be viewed as a whole or in part. Input can be collected on up to four channels simultaneously. Three channels are analog, and the other is used for the ultrasonic motion detector or digital inputs. Features include three LEDs that show CBL status; three keys for transfer, setup, and control of data collection; and an AC adapter port. The unit can also be connected to a personal computer via the TI GRAPH LINK, which is sold separately. An accompanying book provides complete directions and operating instructions as well as six activities that make use of the CBL2 and a graphing calculator. One experiment involves collecting light and temperature data continuously for two days and then analyzing the weather patterns. The appendices include troubleshooting information and a set of command tables for the CBL2. (Author/SSD) ENC-019159

Ordering Information
Texas Instruments, Inc., Attn: Accessories, PO Box 650311 M/S 3962, Dallas, TX 75265
Email: ti-cares@ti.com
(972) 917-6335 / Fax: (972) 917-0747 / Toll-free: (800) 842-2737
www.ti.com/calc
$240.00 per CBL2 package

The Geometer's Sketchpad, Student Edition

Grades 7-12
2000
Author: Steven Chanan

Designed to encourage interactive exploration and discovery of geometric concepts, this software enables students to visualize and analyze a geometric problem or relationship and then make conjectures before attempting a proof. With Sketchpad, students construct geometric objects by combining points, circles, segments, rays, and lines; they can then interactively explore the object's mathematical properties by dragging the object with the mouse. All geometric relationships are preserved, allowing students to examine an entire set of similar cases in a matter of seconds and leading them by natural course to generalizations. The software can be used for guided investigations, open-ended explorations, and demonstrations. The learning guide contains step-by-step instructions for eleven guided tours that introduce the user to the software's capabilities, from doing simple constructions to creating an animated presentation. Also included with the software is a booklet with 101 project ideas that are designed to be challenging. The projects are arranged by category, such as calculus, polygons, and special curves. In a sample set of projects, students create a small program, or script, for a construction that cuts any line segment into two segments so that the ratio of the lengths reflects the Golden Ratio, approximately 1.618. In subsequent related projects, students use their program to construct a Golden Rectangle and a Golden Spiral. (Author/JRS) ENC-019275

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Available to students in schools with site license; must be purchased through schools.

DataStudio: A Tool for ScienceWorkshop

Series: ScienceWorkshop.
Grades 9-12
1999

Part of the ScienceWorkshop series, this CD-ROM features DataStudio software that can be used to record, display, and analyze data and ScienceWorkshop software that is used to access a library of hands-on science experiment templates. The software is intended mainly for use with the separately available PASCO ScienceWorkshop electronic interface device, which can be used with special data probes to measure physical variables such as temperature, pH, and conductivity. Data can be displayed in a number of formats such as line graphs, bar charts, and tables. It can also be plotted as a function of time, or multiple probes can be used to plot one variable as a function of another. The software includes data manipulation and analysis tools that allow users to manually add or edit data, annotate graphs, create or edit equations, and generate best fit curves for their graphed results. An online tutorial is available that uses sample data and a library of pre-prepared experiments to demonstrate the many ways that the software can manipulate and display experimental results. Digital workbooks outline the procedure for these experiments and provide space for students to keep notes and record their observations when they perform the experiments themselves. The ScienceWorkshop software includes full instructions for more than 200 pre-prepared experiments in high school biology, physics, and chemistry as well as experiments suitable for general science and middle school science. The experiments are designed to teach students the principles of experimental design, data collection, and analysis as well as data presentation and interpretation of graphic information. (RJD) ENC-017579

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PASCO Scientific, 10101 Foothills Boulevard, PO Box 619011, Roseville, CA 95678 Email: sales@pasco.com
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www.pasco.com
$99.00 per hybrid CD-ROM

Derive 5: The Mathematical Assistant for Your PC

Series: TI Explorations Software
Grade 9 and up
2000
Author: Bernhard Kutzler, Vlasta Kokol-Voljc

This CD-ROM, with accompanying user's guide, is the latest version of the computer algebra system DERIVE. This software performs symbolic manipulation for algebra and calculus expressions and equations and permits interactive exploration of Euclidean, transformational, and analytic geometry. In addition, it provides three-dimensional surface plots for exploring complex algebraic expressions. It can also perform all the standard functions of scientific and graphing calculators. The software can be used to create worksheets with graphs, text, mathematical expressions, and details of mathematical manipulations edited together to make a presentation. The accompanying user's guide features step-by-step, illustrated explanations of the software's capabilities. The guide addresses such topics as approximate versus exact computations, the plotting of graphs, and the use of the software to do calculus. Educator's footnotes provide teaching suggestions related to the respective topics. A quick reference guide is also included. (Author/MM) ENC-019244

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www.ti.com/calc
Pricing: 1 CD-ROM (Windows) package, includes manual and reference guide
$89.00 per CD-ROM (Windows) package. Individual education license, other packages available

Fathom Dynamic Statistics Software

Grade 9 and up
2000
Author: Tim Erickson

Developed as a National Science Foundation-funded project, this interactive software enables students to gather, explore, and analyze data in a computer learning environment. Multidimensional data collections can be displayed and analyzed with multiple representations. The software features tools for organizing and analyzing data that include sliders for changing variable values, menus and authoring options for defining functions, and animated simulation tools. It also has the interactive capacity to create graphs, in a choice of formats, by grabbing and dragging attribute labels from a data collection. Using the drag feature, students can see relationships between different variables found in the data collection. Manual changes in data or range of a variable are simultaneously reflected in all the related data representations. In addition to more than 300 data sets, the software allows for importing data from text files or directly from the Internet. *Data in Depth*, a book of curriculum materials with activities, is included with the software. Blackline masters lead students through the software basics and more complex investigations, ranging from exploratory data analysis to sophisticated inference. In a sample basic activity, students enter data from Amtrak train schedules, create a scatter plot of distance as a function of time, and use the data to make a formula to determine travel time. (Author/JRS) ENC-019249

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TI InterActive! Integrated Computer Software for Math and Science

Grade 9 and up
2000
Author: Texas Instruments

This interactive computer software package enables high school and college teachers and students to investigate mathematical and scientific ideas. It incorporates a word processor, a graphing calculator, a computer algebra system, and a web browser into one piece of software. This bundling allows users to create a single document in which they could, for example, download and analyze real data from the Internet, generate graphs, perform calculations, and write a complete report that incorporates text, graphics, and calculations. The software can also import, via a graph link, data from other Texas Instruments products, such as the CBL, the CBR, and graphing calculators. The accompanying teacher's guide provides step-by-step instructions for 10 different activities, including rational functions, projectile motion, and area under a curve. In the sample activity Linear Regression, students perform regression analysis on real data to develop a mathematical model that relates the distance an automobile travels after the driver applies the brakes. Students start by finding a hyperlink to some real data, which they extract into a table and use to create a scatter plot. The students paste the graph into their document and write several sentences explaining what they have graphed. They use the Stat Calculation Tool to calculate the linear regression equation and paste the equation into the graph. Each activity includes teaching notes and answer keys. (Author/MM) ENC-019247

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www.ti.com/calc
$64.95 per CD-ROM (Windows) package

Mathematica

Grade 11 and up
1988
Author: Stephen Wolfram

This CD-ROM, with accompanying user's guide, is the latest version of the computer algebra system Mathematica. The program is designed as a tool both for doing mathematics and for learning mathematics and is intended for use by practicing mathematicians, engineers, and scientists as well as educators and students. This software performs symbolic manipulation for algebra and calculus expressions and equations. Users can also interactively explore Euclidean, transformational, and analytic geometry. In addition, the software provides three-dimensional surface plots for exploring complex algebraic expressions. It can also perform all the standard functions of scientific and graphing calculators. The software can be used to create worksheets with graphs, text, mathematical expressions, and details of mathematical manipulations edited together to make a presentation. The latest version includes direct import and export of more than 20 standard data, graphics, and sound file formats, extended HTML and TeX capabilities, and more than 100 new or enhanced functions. The accompanying user's guide provides step-by-step, illustrated explanations of the software's capabilities. The first section takes readers on a brief tour of the main capabilities of the software. The next three sections provide an introduction to the most commonly used tools, an explanation of the principles of Mathematica, and a guide to doing advanced mathematics using the software. Appendices include a complete list of built-in functions and some general notations and conventions. A second guide provides information on standard add-on packages available, including finite fields, Gaussian elimination, and linear regression. (Author/MM) ENC-019349

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www.wolfram.com
$1,495.00 per CD-ROM (specify platform) with texts, Version 4.1
Contact vendor for information on license agreement documents for multiple users, pricing, and format availability information.

Engaging Students with Technology

My Body (Primary)

Series: Internet Quests
Grades K-3
2001
Author: Jody Gabrovec, Ken Tunell

Teachers can use this book and CD-ROM to help their students explore the human body. The Internet activities give students experience and practice in accessing relevant web pages through the Teacher Created Materials web site. They use the information they find to complete the associated tasks on the activity pages. The CD-ROM features a database of information and pictures related to the study of the human body. Its appearance emulates the web sites found on the Internet, and it is navigated in exactly the same way. Students use the information gathered from the files to complete the assigned activity pages provided in the book. General activity pages require the students to utilize traditional print reference materials to complete the tasks on the sheets. The pages of the book are all printed as reproducible blackline masters. One of the Internet activity sheets asks students to explore an Internet site about bones and to complete activities concerning the structure and function of the skeleton. Students also look at information about keeping bones healthy and apply it to their own lives. Information from some of the database pages deals with sight and smell. Students examine the information and then label diagrams and answer questions about these senses. Those activity pages that require general references cover material such as the types of movement found in various body parts, growth and development, and health. (Author/SSD) ENC-019095

Ordering Information
Teacher Created Materials, Inc., 6421 Industry Way, Westminster, CA 92683
Fax: (800) 525-1254 / Toll-free: (800) 662-4321
www.teachercreated.com
$19.95 per activity book with hybrid CD-ROM (Windows/Macintosh)

Technology Tools for Young Learners

Grades K-3
1999
Author: Leni von Blanckensee

Through this book, teachers learn how K-3 students can better use technology to support their learning and development. The technologies discussed are graphic images, word processing, multimedia presentations, email, and videoconferencing. The book provides detailed examples of activities, projects, and lessons which can be adapted by teachers for their own classrooms.

The book starts with a theoretical framework and rationale for the integration of technologies into the curriculum. This is followed by a series of chapters in which details, lesson plans, warnings, and recommendations are given for specific technologies. The final chapters feature a start-up guide to the integration of technology into the curriculum, a guide to taking a school-wide approach, and a summary discussion of the use of technology placed in the context of child development theory. (Author/MM) ENC-018069

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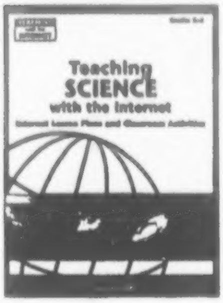
$26.95 per book (paperback)

Teaching Science with the Internet, Grades K-6: Internet Lesson Plans and Classroom Activities

Series: Teaching with the Internet
Grades K-6
1998
Author: Karie Youngdahl



Part of the Teaching with the Internet series, this book contains lesson plans that integrate Internet activities with hands-on activities in life science, human science, physical science, and Earth science. The twenty-eight lesson plans are designed to be completed in one class period. The author recommends modifying the activities for higher or lower grades by adjusting the objectives. Most lessons require only Internet access. The students demonstrate what they have learned on the lessons' worksheets. The book suggests using its companion web site to access the sites included in the main body of the lessons and their extensions. One lesson asks students to interpret weather forecasts for three different locations and draw the clothes that would be appropriate for that weather. Students also look at the meteorological facts behind weather proverbs. They visit The Weather Dude site to gather information, listen to a weather song, and read weather proverbs. As extensions, students choose weather photographs from a gallery of images and visit a cloud library. The appendix contains addresses for science web resources. An answer key is found at the back of the book. (Author/JR) ENC-017682

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www.classroom.com
$37.96 activity book (paperback)

CIESE Online Classroom Projects

k12science.org/currichome.html
Grades 3-12
2000
Author: Stevens Institute of Technology

At this web site are projects that teachers can use to enhance their curriculum through use of the Internet. The site focuses on projects that utilize real-time data available from the Internet and on collaborative projects that utilize the Internet's potential to reach peers and experts around the world. Each project has a brief description and links to the *National Science Standards* and 1989 NCTM standards it supports. In one project, The Stowaway Adventure, live remote sensing data from cargo ships takes students on a virtual adventure where they learn about navigation and use mathematics to calculate their ship's average speed in knots. In the Global Temperature Project, students from around the world team up to investigate the relationship between proximity to the equator and temperature and sunlight variations. The Noon Day Project enables students to join other schools in recreating how Eratosthenes, a librarian in Alexandria in 200 BC, measured accurately the circumference of the earth using sticks, shadows, and a little geometry. In addition to projects, there is an Ask An Expert Page with links to authorities in a number of different fields. (Author/JRS) ENC-012233

Safe Water

Series: Science Seekers
Grades 5-8
2000
Author: American Museum of Natural History
Publisher: Tom Snyder Productions

Developed with the American Museum of Natural History, each module of this CD-ROM-based package provides a mission for student teams to complete using multimedia, cooperative learning, and hands-on activities. Throughout the process, teams collect information to solve the problem and learn from professional scientists how technological advances have increased people's understanding of similar real-world problems. A teacher's guide provides an overview of each component, a set of reproducible student worksheets, and answer keys. The mission on this CD-ROM is to identify the major source of water contamination in the city of Fairview. The local lead mine, landfill, and tannery are presented as options along with a gas station that has been closed down. Once the mission is outlined, student teams explore each option by working through a set of questions on top secret memoranda and successfully completing CD-ROM quizzes. Experiments are also performed that involve creating a groundwater model system, comparing porosity and permeability, and observing how pollution travels from one region in the ground to another. After analysis of data, teams submit their findings to the Center for Science Seekers and wait for confirmation and mission debriefing. (Author/JG) ENC-019280

Ordering Information
Delta Education, Inc., PO Box 3000, Nashua, NH 03061
Fax: (800) 282-9560 / Toll-free: (800) 442-5444
www.delta-education.com
$109.95 per kit (includes Tom Snyder CD ROM of same title)

Shape Makers: Developing Geometric Reasoning with the Geometer's Sketchpad

Grades 5-8
1998
Author: Casey FitzSimons, Dan Bennett, Michael T. Battista, Nicholas Jackiw

This text and accompanying software are designed to provide mathematics teachers with engaging student activities using The Geometer's Sketchpad. Shape Makers was developed with the philosophy that instruction should be inquiry-based, with students learning mathematics as they solve problems and share their ideas with one another. The text includes a discussion of how Shape Makers ties in to the van Hiele levels of geometric conceptual development. The materials are for pairs of students working collaboratively to form conjectures as they explore each activity. Shape Makers is divided into explorations, each consisting of a set of related one-hour class sessions. In each set, students use different templates for a given shape that preserve the properties of that shape. One activity, The Mystery of Polygon Flats, asks students to discover which of six characters (played by different Shape Makers) committed a theft. To do this, students must analyze camera shots of the shapes in the various rooms and manipulate various Shape Makers to find a match with the security camera shots. Teaching notes discuss aspects of instruction as illustrated by teacher-student dialogues taken from actual classrooms. Mathematical notes deal with mathematical and pedagogical issues that require special attention. Student activity masters are included. (Author/RMK) ENC-012573

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Manipula Math with Java

www.ies.co.jp/math/java/index.html
Grade 5 and up
1996
Author: International Education Software, Inc.

This web site uses interactive animation to explore an extensive set of sophisticated mathematical concepts. Each interactive program, or applet, presents a problem with opportunities for the student to do structured exploration. In the applets, relationships between variables presented in the problem can be manipulated, allowing the student to investigate concepts such as the meaning of the Pythagorean Theorem, to find the sum of the outer angles of a polygon, and to calculate the volume of a solid of revolution. Students are able to generate, rotate, and transform three-dimensional figures. Topics include geometry, trigonometry, and calculus. (JRS) ENC-011230

44 Internet Lesson Ideas for Science Classes

Grades 6-12
1998
Author: Scott W. Earle, Thomas W. Alsop, Vincent B. Delumpa

The 39 lessons in this activity book give students themes and ideas to explore on the Internet at various web sites. Students are encouraged to search related web sites, summarize what they find there, prepare a fun activity, and present it to their classmates. For each lesson plan, the book outlines suggestions for activity ideas, step-by-step procedures, sample web addresses of the sites students need to visit, and methods of assessment. The activities integrate Internet activities with hands-on activities in physics, chemistry, and biology. Sample topics include famous scientists, the microscope, and evolution, in addition to properties of matter, chemical reactions, and gravity. In a sample activity, students use a search engine to obtain information on kinetic energy, work energy theorem, potential energy, and the law of conservation of energy. They then use the information from their search to make a poster that shows how electricity can be generated from a dam. The book also provides a general overview of the Internet, ideas for web-based student projects, and a list of Internet resources for classroom use. (Author/YK) ENC-018360

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Teacher's Discovery, Science Division, 2676 Paldan Drive Suite C, Auburn Hills, MI 48326
Fax: (800) 987-2436 / Toll-free: (888) 977-2436
www.teachersdiscovery.com
$24.95 per activity book (spiral-bound, paperback)

Concepts in Algebra: A Technological Approach

Grades 8-10
1999
Author: Charlene Sheets, Glendon W. Blume, James T. Fey, M. Kathleen Heid, Richard A. Good, Rose Mary Zbiek

Rather than focusing on symbolic manipulation, this curriculum offers a new approach to teaching algebra in a technological age. The material concentrates on mathematical models and representations, variables and functions, and symbolic reasoning. The curriculum emphasizes the use of technology as a tool to aid student understanding of fundamental concepts. Students explore mathematics in real-world situations through the development and critique of mathematical models. The idea is that students will develop an understanding of variables, functions, relations, systems, and equivalence as they investigate realistic questions, and that they will come to recognize the need for formal symbolic manipulation as a consequence. Each chapter consists of a series of explorations, beginning in Chapter 1 with an exploration of functional behavior in general. Other chapters cover linear, quadratic, exponential, and rational functions as well as solutions of systems of equations. An instructor's guide explains the philosophy of the curriculum and contains teaching notes for each of the explorations. Also provided are assessments, an answer book for the assessments and explorations, a book of blackline masters for handouts and transparencies, and a computer disk with data related to some of the explorations. (Author/MM) ENC-019294

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Everyday Learning Corporation, PO Box 812960, Chicago, IL 60681
(312) 540-0210 / Fax: (312) 540-5848 / Toll-free: (800) 382-7670
www.everydaylearning.com
$135.00 per teacher's resource package (includes student text, instructor's guide, assessments book, software, answer key, and teaching masters)
Components also sold separately; call vendor for details.

Transforming Functions to Fit Data: Mathematical Explorations Using Probes, Electronic Data Collection Devices, and Graphing Calculators

Grades 8-12
1998
Author: Mary Jean Winter, Ronald J. Carlson

This activity book with CD-ROM contains activities and explorations in which students use data collector probes and graphing calculators to gather data and transform equations to fit the data. In these experiments, students explore functions and investigate the interrelationships among graphs, tables, algebraic expressions, and physical conditions. Experiments explore a variety of functions, including linear and quadratic functions, the integer function, and the square wave function. The CD-ROM contains calculator programs and extra data sets. The activity book contains blackline masters for the activities and teacher notes for each activity. The first set of activities emphasizes the graphical and tabular representations of a function. Students gather data on motion and temperature into a calculator that can display data as a table of values and as a graph. An activity sheet poses questions that require the student to think about the connection between the experiment, the table of values, and the graph. In later activities, students explore how changing the constants in an equation transforms the graph. Students download messy real-world data from the CD and try to write equations to fit the data. A motion detector is also used to analyze the bounce of a basketball and the swing of a pendulum. (Author/JRS) ENC-019281

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$19.95 per book and hybrid CD-ROM

ExploreMath.com

www.exploremath.com/index.cfm
2000
Grade 8 and up
Author: Third Millennium Press, LLC

At this web site are interactive activities designed to help students visualize and explore a spectrum of major mathematical concepts from elementary algebra through precalculus. The activities offer real-time correlations between equations and graphs and go beyond what is possible with a graphing calculator. In one activity, students can move points on a graph and find the distance between the points using an online ruler or the distance formula; in another, they can vary the constants in linear and polynomial equations and observe the related graphs. A third activity lets students manipulate the size of a circle and a rectangle to explore the probability that a dart thrown into the rectangle will land in the circle. Visitors can register to become members and receive a free newsletter; they can also use the site to create and maintain individualized web pages for their mathematics courses. (Author/JRS) ENC-017039

Biology Lessons for Prospective and Practicing Teachers

http://www.biologylessons.sdsu.edu/
Grades 9-12
1999
Author: Chris Roland, Esther Levy, Kathleen Fisher, Laura Becvar, Rebecca Smith, Robert Weeks, Stacy Gomes, Susan Levine
Publisher: San Diego State University, Center for Research in Mathematics and Sciences Education

Both preservice and inservice teachers can use this web site to access biology lesson plans and activities to facilitate students' learning about population biology as well as molecules and cells. The site offers hands-on activities, knowledge mapping exercises, and tables with common student alternative conceptions. Visitors can learn about the educational philosophy that supports the constructivist methods suggested on the site. Hyperlinked terms throughout lesson plans and activities connect visitors to glossary definitions. Many terms are also accompanied by a SemNet icon that connects to a page with a concept map. Students may determine their own paths through the lessons by selecting specific hypertext terms on these concept maps. The maps also have links to other sites with text or pictures that support the concept. Two different types of lessons are provided for each topic within the site's two content sections. The first type of lesson has hands-on activities with questions that raise the students' interests in predictions, explanations, and interpretations of their experiments. The second type of activity involves the use of two versions of the SemNet software, either embedded in the site or in a downloadable version for MacIntosh computers. The SemNet software can be used as a tool for learning, assessment, and diagnosis. SemNet lessons are provided in both English and Spanish. Additional references about pedagogy and content are provided. The lessons are correlated to *American Association for the Advancement of Science (AAAS) Benchmarks for Science Literacy.* (Author/JR) ENC-017879

Modeling Motion: High School Math Activities with the CBR

Series: Explorations
Grades 9-12
1997

The 14 hands-on motion activities in this book use the Texas Instruments Calculator Based Ranger (CBR) and TI-82 or TI-83 graphing calculators. The activities range from algebra through calculus. A table correlates the activity with a mathematics topic. An appendix contains a set of teacher notes and a set of sample data with solutions to questions for the activities. Each activity is on reproducible worksheets and has the same format. The activity starts with a brief discussion of the

concept being investigated. It then lists the materials needed and gives the instructions for analysis using the calculators. The activity concludes with questions about the graphs and the concepts presented in the activity. For example, one activity discuses the relationship between distance, velocity, and time. The students collect data as a walker moves back and forth in front of the motion detector. The data is then transferred to the graphing calculators. Students consider questions such as: How would the motion graphs differ if the walker moved towards the CBR with a constant speed? And, what does it mean when the CBR indicates that a person is moving with a negative velocity? (Author/JAR) ENC-016810

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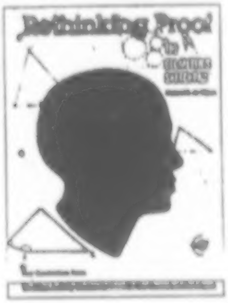
Email: ti-cares@ti.com
(972) 917-6335 / Fax: (972) 917-0747 / Toll-free: (800) 842-2737
http://www.ti.com/calc
$16.00 per book
Note: Call 1-800-TI-CARES for vendor referral and pricing (TI indicates that dealers set prices)

Rethinking Proof with the Geometer's Sketchpad

Grades 9-12
1999
Author: Michael D. de Villiers



This teacher resource includes a book with student activity worksheets and a CD-ROM with interactive images to use in the activities. These materials are used with Geometer's Sketchpad software to investigate the idea that proof is more than verification. Proof is introduced as a means for explaining results that have been experimentally verified with the software. Students use these activities to explore the discovery, verification, challenge, and systemization functions of proof. The book's introduction contains background information about the nature of proof and an explanation of the van Hiele theory, which describes five levels in the development of students' understanding of geometry. References and explanations for all activities are also included. In a sample activity, students determine where to locate an airport so that the sum of the distances to three cities is at a minimum. Students use a sketch found on the CD and a worksheet with suggestions for exploration to investigate the problem. They experiment by dragging the points of a triangle that represent the locations of the cities, use the software capability to take distance measurements, and write a conjecture. Students are challenged to support their hypothesis with a logical explanation or a convincing proof. (Author/JRS) ENC-019276

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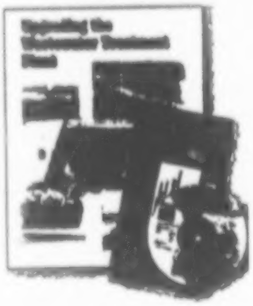
Upgrading the Wastewater Treatment Plant

Series: Science in a Technical World
Grades 9-12
2000
Author: Phil Gauron, Peter Morley
Publisher: W.H. Freeman and Company



Part of the Science in a Technical World program, this interdisciplinary science module is designed to educate students about science technology, industrial processes, and workplace issues. Units in the program can be used as primary material for a tech prep course or supplements for standard life and physical science courses. A video, CD-ROM, and student text work interdependently to introduce an industry-specific problem and develop skills to address and solve this featured problem. Multiple hands-on activities and labs also support the study process and connect learned concepts to real-world applications. Throughout the project the industrial model of teamwork, specialization, and collaboration is emphasized, as well as the importance of keeping accurate notes and following standard procedures. The challenge for students in this resource is to assume the roles of laboratory technicians at the New River wastewater facility and to identify the skills that wastewater technicians must acquire to handle the demands of a plant upgrade. Video footage highlights the methods and careers involved in wastewater treatment, while the interactive CD-ROM provides digital photographs and movies to explain and demonstrate laboratory tests performed at key points in the treatment process. Additionally, a practice section allows students to learn procedures and try virtual onsite laboratory tests, and an assessment section evaluates understanding. Key words link to the glossary or encyclopedia. Sample activities include distinguishing between chemical and physical changes, observing how gases behave in a solution, and monitoring simulated sludge. Utilizing the knowledge it has gained, each team then designs and test-pilots a training program for its facility employees. (Author/JG) ENC-019184

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$14.90 per student edition (paperback)
$38.95 per video
$51.90 per hybrid CD-ROM

Water Quality with Computers Using Logger Pro

Grades 9-12
1999
Author: Dan D. Holmquist, Robyn L. Johnson, Scott Holman

This book contains 16 water quality tests using a laptop computer, Vernier sensors, and Logger Pro, which is software that allows students to collect and analyze data with computers. Offered tests include temperature, dissolved oxygen, and stream flow in addition to tests for fecal coliform, calcium hardness,

and total dissolved solids. A table designates tests recommended for various situations. During the tests, students collect, display, graph, and analyze data collected in the field or lab. Electronic versions of the experiments are found in word processing files on the accompanying CD-ROM, which requires Logger Pro. Appendices explain how to install the word processing files, provide lists of equipment, and suggest related resources. Data from the United States Geological Survey (USGS) and a description of Vernier products for Water Quality are also provided. The book explains how to prepare for sampling, safely collect and test the water, and analyze the results with the Water Quality Index. Following each test, an additional section provides directions for preparing solutions and hints regarding the planning and implementation of a particular test. For example, the test for biochemical oxygen demand (BOD) explains how oxygen is introduced and used in a stream. The section contains two testing methods, one for expected high and the other for expected low BOD. One tip in the additional information section suggests that students make sure they collect their samples away from the surface of the water. (Author/JR) ENC-016654

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Advanced Algebra Through Data Exploration: A Graphing Calculator Approach

Grades 10-12
1998

This textbook for advanced algebra anchors the course content in real-world contexts that students investigate with the tools of technology. The materials provide mathematical investigations and applications that incorporate the graphing calculator and that require work in cooperative learning groups. Integrated within the algebra curriculum are statistics, discrete mathematics, and geometry as well as functions and probability. The textbook employs open-ended and guided inquiry questions. Investigations offer students opportunities to hypothesize and experiment as they analyze, test, and communicate their ideas. The book's combination of projects and real-world applications emphasizes equations and algebraic laws in contextual situations using real data. The text also encourages numerical, graphical, symbolical, and verbal representations of solutions. This approach was influenced by the 1989 NCTM standards. A teacher's guide describes a cooperative learning environment with respect to structuring group work and the teacher's role in facilitating that environment. Suggestions for assessment are also listed along with course outlines and teaching tips for each section in the text. Also provided are extra projects, transparency masters, data disks for downloading data from a computer to a calculator, and complete solutions to problems, along with tips for recording, interpreting, and communicating assessment information. A Quizzes, Tests, and Exams section provides blackline masters and/or a CD-ROM with two quizzes per chapter, chapter tests, and semester exams. (Author/LDR) ENC-009184

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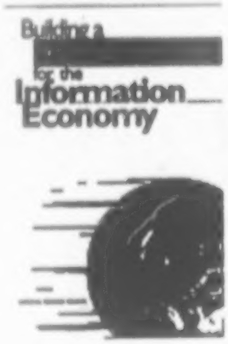
For Further Reading

Building a Workforce for the Information Economy

Grade 11 and up
2001
Author: National Research Council
Publisher: National Academy Press



This report assesses the informational technology (IT) field, identifying the workforce population, required education and training, and the impact of perceived employment shortages. Early exposure to computers, enhancement of critical thinking skills, and reinforcement of positive attitudes about math and science are recommended. (Author/JG) ENC-019234

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The Children's Machine: Rethinking School in the Age of the Computer

Grades 8-12
1993
Author: Seymour Papert

The author of this book explores how the relationship between children and computers affects learning. The book identifies three themes that influence the likelihood that schools will move toward major change in response to technology: identification of current practice in schools, development of a sense of the evolution of the technology itself, and the development of new theories of learning. (Author/JR) ENC-018374

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In Accord with Nature: Helping Students Form an Environmental Ethic Using Outdoor Experience and Reflection

Grades 6-12
1999
Author: Clifford E. Knapp, Howard Kirschenbaum
Publisher: ERIC Clearinghouse on Rural Education and Small Schools

This book is written to help school teachers, youth leaders, and private and public policy interpreters plan, conduct, and assess their educational efforts to help students develop a more complete and defensible environmental ethic. The authors outline perspectives on environmental ethics and present alternative strategies for teaching environmental values lessons. (Author/JR) ENC-017188

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Life by the Numbers: Educational Modules

Series: Life by the Numbers
Grades 7-12
Publisher: WQED
1997

The 13 short modules on this video illustrate the underlying importance of mathematics to everyday life. The tape explores mathematical applications as diverse as the way statistics is used and misused in making election predictions and why an ape could never grow to be the size of King Kong. (Author/JRS) ENC-014138

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$4.95 per video with teaching guide (plus shipping and handling charge for each videotape and teacher's guide. To order the full series you must call PBS 1-800-274-1307)

Song of the Meadowlark: Exploring Values for a Sustainable Future

Grade 7 and up
1999
Author: Bill McKibben, James Eggert, Sally Rogers

This book contains an economist's thoughts about commitments to the preservation of diversity of life and the maintenance of the health of human, cultural, and natural ecosystems. The authors suggest adoption of the meadowlark economists' perspective, in which the principles of economics are combined with an awareness and respect for ecological principles. Meadowlark values lead people to rethink practices of education, habits of consumption, and attitudes toward work. (Author/JR) ENC-018017

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Ten Speed Press, PO Box 7123, Berkeley, CA 94707
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www.tenspeed.com
$12.95 per book

Symbolic Manipulation by Computers: Information, Ideas, and Implications for Mathematics Teaching

Series: Computers in Mathematics Teaching
Grade 8 and up
1996
Author: Sam Boardman, David Bowers, Keith Eames, Terrence Etchells, Joan Flower, Doug French, David Green, Mark Hunter, Paul Marshall, John Monaghan, Adrian Oldknow, Stefano Pozzi, Anthony Robin, Ken Ruthven, Martin Taylor, Ron Taylor

This book is written as both an introduction and a guide to the use of computer algebra systems (CAS) in mathematics education. It consists of a series of chapters that describe various CAS, present teaching activities using CAS, and discuss the implications for teaching and learning. (Author/MM) ENC-018997

Ordering Information
The Mathematical Association, 259 London Road, Leicester LE2 3BE
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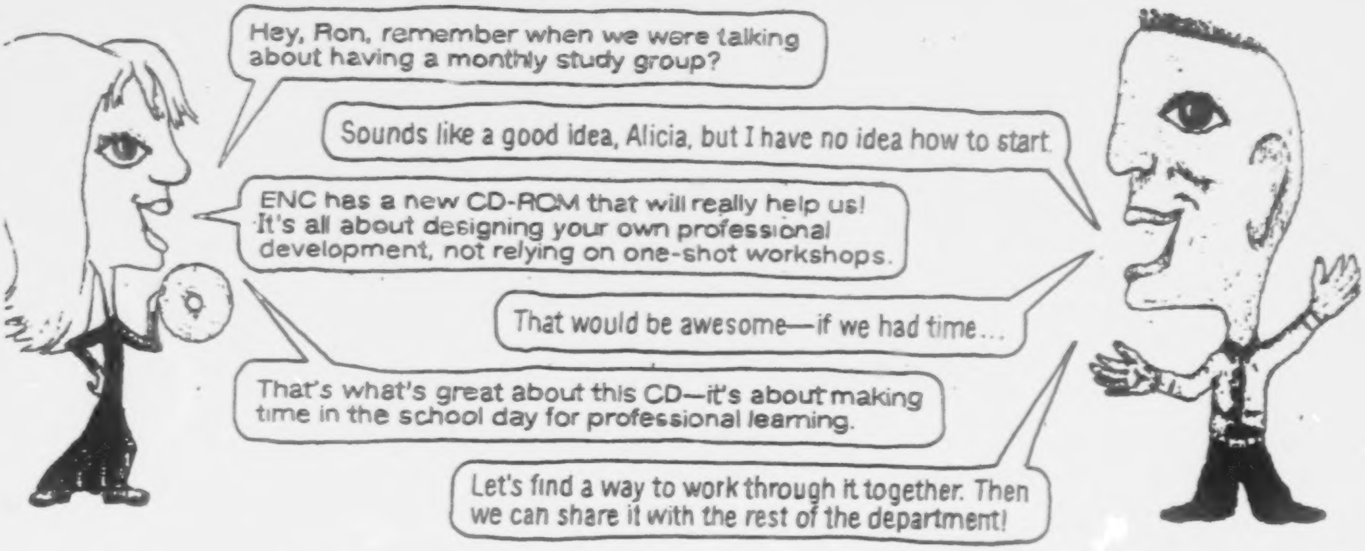
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